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TEACHER EFFICACY: ITS EFFECTS ON TEACHING PRACTICES AND STUDENT OUTCOMES IN MATHEMATICS

By

JULIUS CAESAR ENON ©

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN
PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA
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DEDICATION

This dissertation is dedicated to the following:

My parents, Serafino and Katarina Odio, from whom I learned the meaning of persistence, and for their love, perseverance, and patience.

My wife, Florence, and our children: Brenda Apio, Barbara Akelo, Bridget Adero, Jimmy Awele, and the new born boy

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Abstract

Teachers are very important part of the classroom environment. Teacher expectancies and beliefs have been shown to influence their own behavior, students motivation, attitudes, and achievement. Teacher efficacy is a critical variable in teacher and school effectiveness, more particularly in mathematics and science-related subjects.

This study developed teacher efficacy model and examined the relationship between teacher efficacy, teaching strategies, and student outcomes in mathematics in Ugandan primary schools. The three school groups represented in this study were classified as high, medium or low achievement. The students were also classified as high, medium or low achievers. The sample consisted of 131 teachers selected from the field (n = 75) and preservice (n = 56) ; 1475 pupils (668 boys and 802 girls) between the ages of 9 to 16, classes 5 - 7 randomly selected rural and urban primary schools in selected parts in Uganda.

Data were gathered using two scales administered to teachers: a five point Likert-scale, Teacher Efficacy Scale and Teacher Belief Scale. Students' attitudes toward mathematics and achievement in mathematics were measured using the Mathematics Attitude Inventory and teacher-designed tests, respectively. Data were also gathered using unstructured interviews and classroom observations.

Means, standard deviations, correlation among variables, t-tests, ANOVA, MANOVA, and Multiple regression analyses were derived to answer the research questions. The results of this study as measured by the scales, interviews, and observation were: (a) There was no statistically significant difference in personal and general efficacy with respect to gender, teaching experience, training level, location of school, and school achievement level, (b) Teacher efficacy was a significant predictor of instructional strategies in , and high efficacy teachers were more effective classroom teachers than low efficacy

teachers, (c) Teacher efficacy was not a significant predictor of student attitudes towards mathematics and achievement in mathematics, and (d) Differences exist in student's attitudes toward mathematics and their achievement in mathematics; and mathematics was a significant predictor of achievement. Attitudes consistently correlated weakly with teacher efficacy and teachers' beliefs about instructional strategies in mathematics.

The findings of the study suggest that teacher efficacy might influence teachers' beliefs about the use of instructional strategies and their actual teaching behaviors. But, the influence of latent factors , for example, teaching experience and teachers' level of training are not yet proven to be meaningfully influencing teachers' sense of efficacy.

The significance of the study will help to explore teacher efficacy in relation to teacher attrition- why several teachers who enter teaching leave within the first five years. More over, a disproportionate number of teachers are from such under supplied disciplines as mathematics and science.

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CHAPTER 1 - INTRODUCTION

The Nature of Education

Education is a basic human right to which every individual should have access. People look at it in terms of what it will enable them to achieve. To many, the key function of education lies in its ability to offer or withold the chance to rise in the economic hierarchy (Opolot & Enon, 1990). The very nature of education creates in the minds of those who receive it, attitudes, expectations, evaluations, and aspirations about what they study and their future world. Education is interpreted in a broad sense to cover both formal and informal aspects including nursery, primary, secondary, university and college education as well as cultures in and out of school.

Merret and Tang (1994) reported that formal education (schooling) appears to overshadow informal education. Furthermore, the nature of schooling and the way schools have been structured, that pupils are taught in groups of varying sizes, presupposes that someone should learn to be expert in the management of such groups in order to bring about good learning outcomes (Merret &Tang, 1994). Historically, schooling has served the purposes of cultural transmission, and the culture transmitted has often been that of the dominant groups in society (Cornbleth, 1994).

Members of culturally influential and dominant groups have established and shaped the public school system and its curricula. Eysenck (1990) has highlighted two functions of school: (a) acquisition of knowledge, and (b) acquisition of principles of behaviors, discipline, and character. Although schools serve to sustain more than subvert the status quo, they are not static. Schools reflect societal changes such as gender equity, and computer literacy, and convey the dominant culture and cognitive structure of society (Cornbleth, 1994). Schooling is hierarchical ranging from elementary (primary) as the lowest to university as the highest. Although higher education contributes to increases in labor productivity and long term economic growth, focus on primary education has a more direct effect on poverty reduction (World Bank, 1986).

The primary goal of schooling is assumed to be student-learning and achievement through the teaching endeavor that requires teacher effectiveness. One of the most important questions regarding school learning is how well students can transfer their learning to new situations. Educators throughout the world aspire to foster the development of problem solving skills and various higher mental processes in students. They believe and hope that the acquisition of higher mental processes will enable students to use their knowledge more effectively and efficiently long after school. Therefore, if school learning is to be beneficial to the individual as well as to society, school instruction should emphasize the development of higher levels of thinking in a wide variety of higher mental process objectives (Levin, 1986; Swartz & Perkins, 1990). This vital function is the role of classroom teachers because they play a fundamental role in guiding the learning of students (Brophy, 1986; Clark & Peterson, 1986; Shavelson & Stern, 1981).

A body of research has shown that teachers play an important role in guiding their own teaching as well as student learning and achievement (Brophy, 1986; Clark & Peterson, 1986; Shavelson & Stern, 1981). Research indicates that teacher effectiveness in guiding student learning and achievement depends on a number of fundamental teacher characteristics such as teaching experience, beliefs, cognitive style, self-efficacy, and knowledge of content (Woolfolk & Hoy, 1990). Clark and Peterson (1986) suggested that the more elaborate and sophisticated a teacher's conception of instructional goal to be pursued, the greater the likelihood of the design and delivery of thoughful lessons.

Purpose of the Study

The study was designed to explore teacher efficacy feelings among teachers and its effects on teaching practice of teachers and on student outcomes. The focus of this study was prompted, in part by the influence of efficacy on teachers' teaching behavior (Ashton

& Webb, 1986), and in part due to the importance the government of Uganda is beginning to attach to effective teaching and good academic performance in mathematics (Uganda Government White Paper, 1992). This study was conducted in Uganda in response to the Uganda government's repeated concern about the lack of effective teaching in most subjects, particularly mathematics and science, in schools in Uganda.

Mathematics and science achievement in schools is becoming an important concern of both parents and politicians. This concern is a reflection of the importance of good performance in mathematics and science to participation in a wide variety of career fields, particularly scientific and technologically based ones. But more particularly, this concern highlights the importance of teaching these subjects in a way that provides a good grasp of the knowledge base. This concern suggests that teachers, students, and the learning environment might have some effects on teacher practices as well as students' dispositions and achievement in mathematics and science.

Surveys continue to show global mediocre and poor performance of students in mathematics (Dossey, Mullis, Lindquist & Chambers, 1988). These surveys in America suggest that American students perform poorly because they are underexposed to the rigorous progression of mathematics content and translation observed in other countries. On the other hand, Japanese students have been among the top scorers in cross national studies in mathematics achievement because, in addition to the considerable resources they devote to education, their teachers are spirited, and energetic and their students become dedicated and enthusiastic to learn (World Bank,1983).

Available research shows that teachers can enhance academic performance of learners. Students' greater understanding of concepts can be influenced by motivating students and by using effective teaching strategies related to the learning problem and by motivating learners. Every important cognitive act has motivational consequences that potentiate future self-regulatory actions and feelings of self-efficacy (Borkowski, Carr, Rellinger, Pressley, 1990).

Research has documented that teachers' beliefs play a crucial mediating role in their classroom practice (Clark & Peterson, 1986; Shavelson & Stern, 1981; Tobin, 1987). It is assumed that certain dimensions of teacher's thought contribute to differences in observed instructional practices of teachers. If some of the dimensions of thought could be identified, these differences could provide clues to influencing classroom practice.

Further research has documented that teachers' sense of efficacy influences patterns of behavior known to yield pupil attitude and achievement (Ashton, Webb & Doda, 1983; Gibson & Dembo, 1984). It has also been found behavioral differences in teaching practices between high and low efficacy teachers (Ashton & Webb, 1986). These differences affect pupils' attitudes and achievement in any content. Some researchers (e. g. Ashton et al, 1983) believe that teachers' sense of efficacy can be a predictor of teacher behavior. Therefore, one could speculate that teachers who believe that pupil learning can be influenced by effective teaching and who also have confidence in their own teaching abilities would provide an environment that would enhance pupil learning and achievement.

The major purposes of this study were to develop a model of teacher efficacy and to test certain portions of the model. The proposed model examined the relationship between teacher efficacy, teaching practice, and student outcomes. Specifically, the model portrayed both the antecedents of teacher efficacy and the influence of teacher efficacy on teaching strategies and classroom organization of mathematics teachers in Ugandan primary schools. Further more, the model depicted the impact of teacher efficacy on Ugandan students' attitudes toward mathematics and their achievement in mathematics. The model also portrayed the impact of the two dimensions of teacher efficacy, personal and general efficacy, on teachers' beliefs about instructional strategies and student outcomes. The impact of whether a teacher is high or low efficacy was examined on actual teaching strategies used and classroom organization.

Significance of the Study

Hackett & Betz (1981) proposed that self-efficacy might serve as an important career development mechanism, influencing the educational career decisions, achievement behavior, and career adjustment of men and women. Sense of teacher efficacy is considered to be a variable that influences teachers' actions:

> Teachers' sense of efficacy is a construct thought by researchers to intervene between many variables that contribute to the perception by the teacher of his performance as well as to his actual performance and to the achievement of his students. In other words, a teacher's confidence is thought to be a basis for more productive teaching (Dehnman & Michael, 1981, p. 39).

The assumption is that the teacher's feelings give direction to teaching behavior, which in turn influences pupils. Efficacious teachers are more likely to have a strong academic focus in class. Such teachers may tend to use elements of instruction used by effective elementary school teachers - structured academic activities, extensive content coverage, monitoring of students' performance (Bandura, 1986).

If teacher's sense of efficacy beliefs have the potential to influence the behavior of teachers and pupils, then research on the influence of teacher efficacy would provide useful information on the impact of teacher efficacy. An investigation of teacher efficacy and its impact on teaching behavior before and during instruction, could reveal discrepancies and/or congruencies between teachers' teaching practices and students' attitudes toward mathematics and their achievement in mathematics. This study, therefore, holds some theoretical and practical importance for teachers, school administrators, government officials, and policy makers.

1. If teacher efficacy is important, then it would become imperative for educators to determine ways to manipulate and enhance antecedents of teachers' sense of efficacy such

as teacher training, teaching experience, school system and personal variables (Denham & Michael, 1981).

2. This study will assist in isolating indicants or antecedents of teacher efficacy, especially those related to teacher training and job satisfaction. If, as Ashton (1984) asserts, "a potentially powerful paradigm for teacher education can be developed on the basis of the construct of teacher efficacy" (p. 31), then studies such as this are both intriguing and necessary.

3. The model of teacher efficacy advanced within this study will increase our understanding of classroom behaviors of teachers with regard to the sense of efficacy. The model will suggest the need for efficacy training for preservice teachers based on the awareness of the impact of teacher efficacy on student learning (Ashton, 1984; Gorell & Capron, 1989).

4. There might be need to determine the extent to which the sense of teacher efficacy influences pupil learning and achievement. Once this relationship is determined, then attention could focus on the effective ways of enhancing teachers' sense of efficacy in order to improve their mathematics performance as well as pupil performance in all subjects. More significantly, the concept of teacher-efficacy may call for teacher education program revision to assess changes in feelings of preparedness to teach (personal teaching efficacy) which may lead students to expend effort or persist at tasks which promote learning (Ashton & Webb, 1986).

5. Knowing if teacher efficacy relates to teaching effectiveness, students' attitudes toward mathematics and achievement in mathematics will contribute to the profile of teachers who are easily susceptible to leave the teaching profession for greener pastures. In terms of staff development, the study will initiate insight into how schools and colleges can enhance a teacher's sense of efficacy and thereby influence that individual's degree of commitment to teaching.

6. Teacher efficacy is still largely unexamined in Uganda, and this study may provide the opportunity to address this question and explore how it relates to teachers' teaching practices and students' attitudes and achievement in mathematics and other subjects. In addition, this study will add to the information available on teacher efficacy and will indicate the relationship between efficacy and measures of pupil attitudes and academic achievement.

7. If effective teaching strategies are meaningfully identified according to teachers' perceptions, and how they are used in actual teaching, they can be ameliorated by administrative policy especially by the Inspectorate section of the Ministry of Education, through constant monitoring of teachers' instructional strategies in mathematics as a way of ensuring that mathematics is being taught for understanding.

8. Policies can be formulated with regard to the sensitivity and fundamentality of mathematics and science in peoples' careers and economic development. In particular, policy makers could develop an insight into the many dimensions essential in improving mathematics and science teaching in class and consequently knowledge obtained can be applied to relevant areas. Teachers and researchers will be exposed to some meaningful ideas of effective teaching strategies which they can explore to improve their effectiveness in teaching mathematics and science.

9. If the study shows that latent variables such as teaching experience, school effectiveness, age of students, teachers' and students' gender, and location of school can influence teacher and student variables, then these issues will become important dimensions for government officials to consider in planning inservice and professional growth.

10. The characteristics manifested by teachers such as teacher-efficacy, cognitive styles, attitudes, and perceptions may be re-examined and re-explored by researchers in the light of how they relate to teachers of science and mathematics. If inappropriate teacher behavior results from lack of sufficient awareness of both their own and pupils' characteristics, then mechanisms to assist teachers become more aware of instructional

behavior and its effect upon pupil learning, need to be developed. If instructional behaviors of teachers shape students' attitudes toward mathematics, perhaps emphasis could be increased during teacher training or through inservice workshops to encourage effective instructional strategies that will facilitate the development of positive attitude toward mathematics.

11. Research on teachers' conceptions of mathematics instruction and its teaching can be used as an impetus for mathematics teacher educators to re-examine aspects of their work (Collier, 1972) and to determine competencies or basic skills about understanding teaching from teachers' perspectives, which would complement teachers' growing understanding of learning from learners' perspectives to highlight the importance of teacher reflection as a vehicle for knowledge growth.

12. Students' attitudes toward mathematics and their achievement in mathematics may, in general, be an indicator of teachers' effectiveness in the execution of their teaching roles. If the status of students' attitudes is identified, it will provide an opportunity for teachers, teacher trainers and educational administrators, an opportunity to reflect on how to improve instruction of mathematics, in order to make mathematics appealing to students, and sharing ideas through inservice training programs and workshops.

CHAPTER 2 - LITERATURE REVIEW

This chapter presents a literature review on teacher efficacy and its impact on teachers' behavior and student outcomes in mathematics. In particular, the literature will first review the social psychological context of teaching. Next, the literature will review student outcomes in mathematics by examining attitudes towards mathematics and achievement in mathematics. The literature will also review differences among teachers' classroom practices and teachers' beliefs about the teaching of mathematics. Further on, literature will end with teacher efficacy and its relationship with teachers' beliefs about the appropriateness of instructional strategies in mathematics as well as actual instructional strategies used by teachers and students' attitudes toward mathemetics and their achievement in mathematics.

Because this study focuses on Uganda, it is useful, first, to provide a broader educational context (historical and contemporary) of Uganda. Many aspects of schooling in Uganda are similar to those of other countries (e.g. Britain, Canada, China, Japan, & USA). It is those similarities that permit meaningful comparisons or references to be made (e.g. curriculum, examinations, educational policies, career paths and aspirations, and achievements).

Education In Uganda

History of Education In Uganda

Before the influx of Europeans into Uganda and other parts of Africa, the indigenous people had their own education where the home was the school and the fire place was the classroom (Kenyatta, 1963). Everybody played the role of teacher and learned from each other based on one's skills. Teaching and learning were conducted within context, with an emphasis on a way of living in society. Important elements of this education included skills and values like hunting, pottery, wrestling as well as virtues and vices of society like obedience and oracy (Kenyatta,1963).

Uganda's formal education developed since Europeans went to Uganda with the establishment of the first school in 1901. The European system was predominantly based on reading, writing, and arithmetic (3R'S) with a clear dichotomy between the teacher and the learner. The dissemination of knowledge did not directly address the life, needs, and context of the people (Kenyatta, 1963). Today, formal education in Uganda is still characterized by the acquisition of the 3R's and provides the fundamental source of employment and economic success.

Since independence in 1962, in principle, much of the post independence education in Uganda has been guided by the Castle Commission (1963), which laid emphasis on the equality and opportunity to education for all. This included raising standards of agricultural and technical education, expansion of girls' education, and promotion of adult education (Uganda Government White Paper, 1992). But in practice, good educational facilities have only been available to a small elite group (Uganda Government White Paper, 1992). Literacy rate is still low, about 51.7% among those 15 years and older, with 37.8% of males and 65.1% of the females still illiterate (Unesco, 1993). The popularity of school education in Uganda has, however, grown to such an extent that most people appear to be interested in its availability than in its content (Obote, 1969). Most people are more concerned with the attainment of the education rather than its quality.

The education sector has faced many problems. The quality of the education which used to be one of the best in Africa, eroded due to civil strife and the consequent economic decline, especially in the 1970's. Instructional materials are in short supply. Teachers are poorly remunerated and are demoralized. There are many unqualified teachers in schools. About 40% of school going-age children do not enter schools. There is an imbalance in education between urban and rural areas, and between boys and girls (Uganda government White Paper, 1992).

In the last decade, there has emerged a strong feeling and belief that the present education system in Uganda is not relevant to the needs of the people (Odaet, 1982). The bureaucrats argue that the present system is highly influenced by the western system, and produces theoretical elites. It is highly dominated by undue emphasis being placed on rote learning, memorization, and recall of factual knowledge at the expense of critical thinking, cognitive knowledge, reasoning and problem solving skills, and the ability to apply knowledge to new situations (Uganda Government White Paper, 1992). The graduates of this system are have inadequate basic and practical skills and are viewed by critics to be job seekers, rather than job makers. Their contribution to the economic development of the country is reportedly minimal and insignificant. Recently, Nyerere's (1967) ideology of education for self-reliance (Ujama) has started to influence the education policy makers in the country by improving the quality of education attained. The ideology suggests that education should be relevant to the needs of people and should provide practical skills for rural and economic development.

Current Educational Concerns In Uganda

The present educational system includes seven years of primary, four years of ordinary and two years of advanced secondary school, respectively, and three to five years of tertiary and University education. On the average, the primary section is attended by only 60% of school-going age children - 6-12 years of age (Uganda Government White Paper, 1992; Unesco, 1991) because of problems such as the inability to pay tuition fees, rigid cultural attachment, inaccessibility to schools, and many other social and personal difficulties. In addition, many of those children entering primary schools are relatively much older, and about 60% of those who enter primary schools do not complete the primary cycle. About 90% of those who complete do not proceed to secondary schools. Girls, the disabled, and the rural students are more adversely affected by these problems (Uganda Government White paper, 1992).

The curricula in primary schools is comprised of mathematics, science, English and social studies which comprise of geography, history, political education, and religious education as core subjects. Other subjects such as vernacular languages, physical education, handwork and music are very much neglected by teachers. In the lower section (Primary 1 to 3), reading, writing, and music are prominent subjects. At the end of the seventh year of primary education, the Primary 7 candidates write the Primary Leaving Examinations (P.L.E.) conducted by the Uganda National Examinations Board (UNEB). Those who obtain good aggregates (4 to 12) proceed to secondary schools regardless of whether or not their performance in mathematics or other subjects is satisfactory (UNEB, 1985).

Teachers who teach in primary schools are non-degree graduates from Teacher Training Colleges (TTC'S) where they obtained a teaching certificate in education (grade 3 status) issued by the Institute of Teacher Education through the Ministry of Education. Unlike secondary school teachers, the primary school teachers do not specialize in particular subjects. They are expected to teach any subject in any class assigned to them by their respective school administrators. Although there are many female teachers in schools, they are disproportionately under-represented in mathematics and science areas as well as in the upper classes. This under-representation is also reflected in female students with the majority not wanting to study mathematics and science-related subjects optionally (Uganda Government White Paper, 1992).

The quality of the teachers is fundamental and both the educators and government are concerned. The Education Policy Review Commission's (1989 cited in Government White Paper, 1992) significant statement on teachers and teacher education that "... no education can be better than the quality of its teachers, nor can a country be better than the quality of its education" (p.152) bears testimony to the importance of quality of teachers. This statement suggests that "it is the quality of teachers which ultimately determines the lot of the nation". There are significant differences in the quality of most schools with some exhibiting high academic excellence and others exhibiting exceptionally poor academic performance. These differences are reflected in terms of urban or rural location of schools, school foundation, regions or districts and school organization (e. g. teachers' abilities, availability of learning materials, school administration).

Like elsewhere in the world, the government of Uganda attaches great importance to the development of education in the country. The government recognizes the fact that education is a powerful tool for the transformation of society by achieving moral, intellectual, ideological, cultural and social independence and advancement, as well as achieving national goals of unity, democracy, economic progress and security for all citizens (Uganda Government White Paper, 1992). Since 1981, the government of Uganda has formulated broad long-term objectives to make primary education available to every individual so as to enable them to acquire the necessary basic skills, cultural awareness, and for full and productive life after school within a dynamic changing society. In addition, schooling would also provide sufficient manpower of the type and quality necessary to meet the workforce requirements in the country (Odaet,1982).

The Uganda Government prosperity initiative in education led to the appointment of the Education Policy Review Commission (1989 cited in Government White paper, 1992) to inquire into policies governing education in Uganda. The Commission and the government noted the undue emphasis the Castle Commission (1963) placed on the acquisition of theoretical knowledge at the expense of cognitive and developmental knowledge, beneficial skills, values and attitudes. The commission's recommendations advocate the reorganization of the education system to produce intellectual, creative, innovative, scientific and practical minds, skills and abilities with relevance to the people.

In this regard, The Uganda government has begun to shift greater attention toward the teaching and learning of mathematics and science in schools, colleges, and universities. The government is trying to re-address the teaching of mathematics and science in schools and students' performances in examinations. To encourage and motivate mathematics and science teachers, the government has tried to pay them special remuneration. Mathematics and science-related subjects now stand high in the government priority for immediate attention.

Academic Performance in Mathematics

The government is in improving the teaching and achievement of all subjects but the significant need to advance mathematics and science in Uganda is becoming especially evident. Mathematics is one of the few compulsory subjects taught in schools, right from Primary 1 up to Secondary 4. It is one of the major examinable subjects in both local and national examinations with the weight of 100%. In addition, it forms a fundamental requirement for admission into most science based courses and technical-related jobs.

Unfortunately, in all levels of the education system, more school failures are caused by mathematics than by any other subject (UNEB, 1985). This phenomenon has created negative attitudes towards mathematics right from lower levels to university. Even most teachers and parents appear to demonstrate such negative attitudes toward mathematics. This negative attitude may have adversely affected performance of most students. There is a great disparity between individuals and between schools in mathematics performance (see Table 1). Some individuals and schools score very high while some others score very low in mathematics and science-related subjects. The worst results in the Primary Leaving Examinations and other levels are more pronounced in mathematics than in other subjects (Government White Paper, 1992).

Table 1

PLE Results Showing Distinctions And Failures Of An Example Of A School Of High And One Of Low Achievement

	English		Social Studies		Science		Mathematics		
	D	F	D	F	D	F	D	F	Class total
1989: H.A.	320	-	123	7	209	4	215	9	359
L.A.	4	27	5	23	4	24	3	18	41
1990: H.A.	306	-	261	1	199	-	214	6	322
L.A.	1	27	2	22	7	15	2	26	41
1991: H.A.	327	-	106	-	235	-	230	1	353
L.A.	5	30	3	39	1	45	4	28	71
1992: H.A.	358	-	280	5	321	1	260	8	368
L.A.	3	28	11	15	1	37	2	44	53
1993: H.A.	389	-	309	-	328	-	319	4	399
L.A.	3	25	8	15	2	30	1	40	55

D= Distinctions (Division 1& 2 - above 65%) F= failures (Division 7 to 9 - less than 30%)

H.A. = high achieving school L.A.= low achieving school

Table 1 compares the results in distinctions and failures in mathematics and other subjects for schools with high and low achievement in the Primary Leaving Examinations. The table shows that schools with high achievement perform as well in mathematics as in other subjects. They record very few failures in mathematics as well as in other subjects. The schools of low achievement, on the other hand, record poor performances in mathematics. Results in other subjects are also not very encouraging.

Many reasons have been advanced to explain this disparity which include (a) variation in school policies and practices, (b) stability of teachers, (c) level of training, (d) personal and internal factors such as efficacy and belief, (e) location of school, (f) background of the children, and (g) learning environment. The most common attribution for the disparity is directed to the teaching practices and behaviors of teachers. The effectiveness of teaching which is believed to depend on teacher characteristics is a big issue. More attention is being directed toward the improvement in mathematics teaching through teacher motivation so that academic performance also improves.

Summary of Education in Uganda

School education in Uganda is experienceing a transition. The government would like to see an immediate reorganization because it is believed to be too elitist in nature. Some subjects like mathematics are in an unfavorable state and student performancein mathematics is poor. Many factors might be interacting to influence the teaching and performance in mathematics. There is an attempt to improve the education, especially the teaching and learning of mathematics and the training of mathematics teachers.

The Nature of Mathematics

Mathematics is known as the third "R" and its importance is becoming evident because of its place in the school curriculum and its impact on society (Bachor & Creaklock, 1986; National Council of Teachers of Mathematics, 1989). Mathematics has proven to be useful in all branches of science and technology, and competence in mathematics has been identified as a critical skill directly related to educational and occupational choices (Meece, Parsons, Kaczala, Goff & Futterman, 1982). A strong background in mathematics is necessary for many careers and job opportunities in the increasingly technological society of the present time. Because of this appreciable role, mathematics is a compulsory subject in school systems everywhere (Meece et al, 1982), including Uganda.

The National Council of Teachers of Mathematics (1989) proposed that the four main goals of teaching and learning mathematics are to enable all students to:

1. learn the value of mathematics to society,
2. gain confidence in their own abilities to do mathematics,
3. learn to reason and communicate mathematically, and
4. become mathematical problem solvers.

A further emphasis of teaching mathematics is that both a conceptual (ideas of mathematics) and a relational (the connection between the procedures of mathematics) understanding of mathematics should be effective (Van de Walle, 1990). In addition, educators are recognizing that mathematics knowledge is fundamental for all students, including those with special needs (Liedtke, 1991).

NCTM (1989) has noted that a radical change has occured in the last decade in what is considered to be the nature of mathematics teaching and learning. The Council suggests that emphasis in mathematics teaching should be placed on problem solving, communication, reasoning and connections within the mathematics curriculum as well as with other subjects, as opposed to traditional views of mathematics of recall of facts, doing isolated numerical calculations, and a hierarchical structure of topics. This new perspective rests on "teaching for understanding, student-sense making, higher order thinking or acquisition of repertoire of strategies" instead of only single teacher-defined strategy (Khisty, 1994).

What sort of mathematics schools should teach is the focus of many national debates, especially in countries with centralized curricula (Ridgway & Passey, 1995). One view asserts that mathematics is an hierarchical subject where better learning depends critically on earlier learning (Ridgway & Passey, 1995). Mathematics instruction is dependent on previous instruction that provides entry behavior (Hiebert & Carpenter, 1992). It is, therefore, reasonable that students perfect their technique at lower level, before they progress to the next level.

Research by Stevenson, Lee, Chen and Stigler (1986) has revealed that the United States and Japan which are technologically and industrially advanced, devote considerable resources to education but poor academic performance is still recorded in America. To help children in understanding mathematics lies in the ways students are taught in schools, especially in enhancing critical thinking, which requires effective teaching of the subject (Miller & Lieberman, 1990). Several explanations why children have problems in mathematics have been advanced by Bachor and Creaklock (1986). These may include:

1. poor preparation of teachers, which results into poor attitude poor instruction of teacher,
2. negative attitudes of teachers toward mathematics,
3. a general lack of students' readiness in the visual-motor and concrete experience areas that relate to mathematics,
4. student problems in abstract and conceptual thinking,
5. poor attitudes of students and lack of motivation,
6. pervasive effect of reading problems,
7. a high frequency of students who come to a new curriculum without having mastered the prerequisite skills, and
8. the emphasis on literacy in the curriculum which results in less time devoted to mathematics, which leads to lack of coverage of the curriculum, especially in the primary schools (Bachor & Creaklock, 1986).

It is clear that several factors, independently or jointly, affect the teacher's effectiveness inteaching mathematics. For example, this can include teacher's sense of efficacy, attitude towards the profession, knowledge of content, level of training, and job satisfaction.

The Social-Psychological Context Of Teaching

An analysis of the milieu in which teaching and learning occur is essential to the understanding of characteristics of teachers and their influence on pupil learning and achievement.

The Current Status of Teaching Profession

Historically, teaching has been regarded as a noble, white-collar profession that is easily accessible but the feeling of social and economic impact on the profession is adversely significant (Ashton & Webb, 1986). While the salaries have risen substantially in other professions, those of the teaching profession are low. Inflation is adding to the problem and blue-collar jobs are potentially attracting the able individuals away from the profession.

> The teaching profession is caught in a vicious cycle, spiralling downward. Rewards are few, morale of the teachers is low, the best teachers are bailing out, and the supply of good recruits is drying up. Simply stated, the profession of teaching is imperiled (Denemark & Nutter, 1984, p. 204).

This statement also applies to the teaching profession in Uganda. Teaching is an imperiled profession in Uganda because it deprives many teachers of their motivation and sense of professional esteem. The unmotivating teaching situation is driving many teachers to abandon the profesion. Unless something is done to overcome the demoralization of its teachers, it is unlikely that any reforms will improve significantly education of Uganda. In brief, teacher internal characteristics such as efficacy are fundamental in ushering a strong feeling of attachment to their profession and ability to influence student learning.

Ashton & Webb (1986) reported that many teachers claim that parents and the whole society are demanding too much from them. Teachers feel squizzed between the high expectations the public holds for education and the working conditions that make it difficult to perform. Teachers come to their work with aspirations for vertical mobility, but find little opportunity for advancement. They experience little of job satisfaction, too much of conformity to authority, alienation and powerlessness as well as self-estrangement. All these and many other conditions not mentioned here are impediments to effective instruction and are likely to lead to poor student achievement.

The Teacher and Learner Interaction.

Teaching is a complex problem-solving activity of orchestrating a chorus of learners, the goal of which is to facilitate student learning - declarative, procedural, and conditional hnowledge (Kameenui & Simons, 1990). There are many different definitions of teaching but each seems to share common critical attributes (Anderson & Burns, 1989). Teaching can be considered to be (a) a process, because teaching involves action; (b) an interpersonal activity, because a teacher and students interact in bidirectional manner; (c) an intentional practice, because teachers teach with a purpose; (d) an art, because it requires communication ability, perception, cooperation, and appreciation; and (e) a science, because it requires the teacher to identify problems and formulate logical steps to reach the learning goals (Anderson & Burns, 1989; Flinders, 1989).

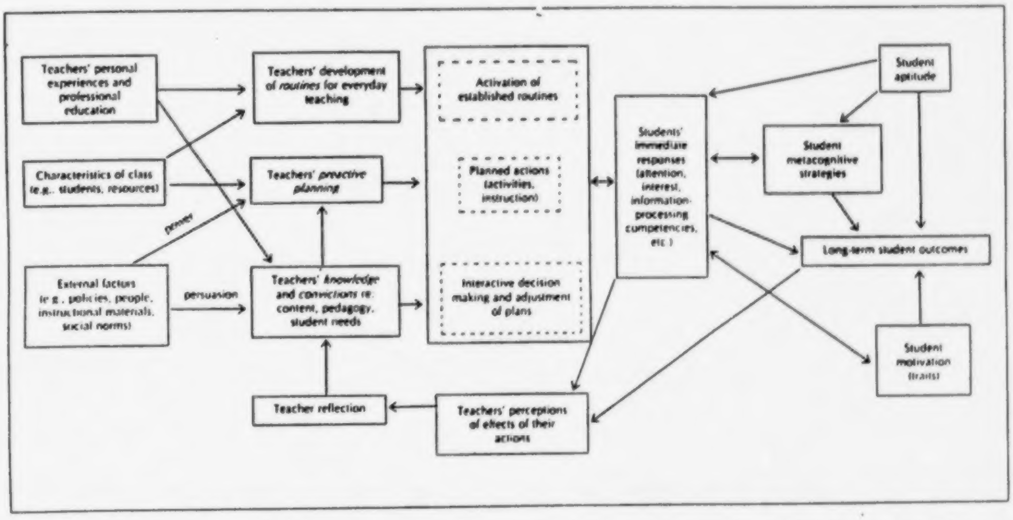
The teacher is faced with "unpacking" instructional interaction to facilitate effective learning and/or identify causes of functional inadequacy (Kameenui & Simons, 1990). This difficult task requires a teacher to consider the learner, the teacher himself or herself, and the content being taught. Teaching also requires the teacher to know enough about the universe of knowledge (Kameenui & Simons, 1990).

Classroom learning involves the interplay of many variables. Some authors have emphasized language, human interactions, and the socialization process that occurs within the classroom. Other authors have considered interactions between teaching styles and methods, learner variables, and the nature of the situation in which learning takes place. Thus, the quality of classroom instruction is a function of ecological, curricula, and teaching variables (Resnick,1981). Resnick notes that the facilitation of effective learning requires skillful teaching which is, unfortunately, difficult and cumbersome. It involves developing and manipulating relevant strategies that can enhance active mental processing and the achievement of learning goals.

Porter and Brophy's (1988) model of teaching (see Figure 1) illustrates the numerous intervening variables between teaching and student learning and achievement in any content area. The model emphasizes the sheer complexity of the teaching task and the milieu in which it is conducted. The model presents factors that influence teachers' instruction of particular academic content, including information that teachers might consider during preactive planning of instructions and actions during interactive teaching. The model also portrays how background and milieu factors influence teachers' professional development and these, in turn, influence planning of instruction, which influences the nature of instruction.

Figure 1

Model of Factors Influencing Teachers' Instruction of Their Students in Particular Content


Teachers' personal experiences and professional education
Teachers' development of *routines* for everyday teaching
Characteristics of class (e.g., students, resources)
Teachers' *proactive planning*
power
External factors (e.g., policies, people, instructional materials, social norms)
persuasion
Teachers' *knowledge* and *convictions* re: content, pedagogy, student needs
Activation of established routines
Planned actions (activities, instruction)
Interactive decision making and adjustment of plans
Students' immediate responses (attention, interest, information-processing competencies, etc.)
Student aptitude
Student metacognitive strategies
Long-term student outcomes
Student motivation (traits)
Teacher reflection
Teachers' perceptions of effects of their actions

Source: Porter and Brophy (1988)

Learning approaches. Current educational thinking recognizes learning to be a multifaceted, complex phenomenon involving the dynamic interaction of cognitive, metacognitive, affective, and ecological variables (Shuell,1986, 1990). Today's assumptions about the nature of learning and thinking are interactionist and constructivist ones. Students should be active learners, animated thinkers, and be intensely involved in the learning activity (Jones & Friedman,1988: Joyce, 1985).

The constructivist theory proposes that learners "construct" knowledge in their minds when they connect prior learning and experiences to new learning. Students make meaning of the world around them as they interact with information and materials in a rich and diverse environment. The constructivists embrace a cognitive umbrella of high-order thinking, teaching for transfer, collaborative learning and metacognitive reflection as the essential ingredients for developing the human potential in all students (Glaser, 1984). The implication derived from constructivists suggests that teaching should be designed, not to put knowledge in the learners' heads but to put learners into positions that allow them to construct knowledge (Glaser,1984). In the final analysis, it is the teacher who manipulates the learning environment to provide the best opportunity for learners to grow and develop.

Teaching is highly complex, and it requires effective negotiation through this complexity (Porter & Brophy, 1988) to facilitate effective learning. Effective teachers tend to be well organized, task-oriented, efficient, clear, self confident, friendly, and alert to student differences. They select appropriate content and are also encouraging and supportive to students (Cruikshank, 1986). Differences among teachers lead to differences in their teaching practices and behaviors. In most cases, these differences are reflected in students' attitudes toward a subject and their corresponding achievement.

Summary of Social-Psychological Context of Teaching Mathematics

Mathematics is important in society and it should be taught in schools. The teachers' role in teaching is complicated by many factors. Mathematics teaching should recognize the importance of learners being actively involved in the learning process.

Attitudes Toward Mathematics

The importance of the affective domain (e. g. attitudes, efficacy, emotions, expectations) in the learning and teaching of mathematics has been highlighted in the past (Bloom, 1976). Teachers and researchers alike seem to stress the importance of pupils' attitudes, beliefs, and interests in understanding school achievement. According to Reyes (1980):

> Not only do attitudes toward mathematics influence a student's willingness to enroll in more mathematics courses, but these attitudes also influence how much effort a student will put into learning mathematics after enrolling in mathematics classes. Students who have positive feelings about mathematics exert more effort, spend more time on tasks, and are more effective learners than students with poor attitudes (p. 163).

Attitude is derived from Latin "aptitudo", which means "fitness", and it has taken different meanings. Mathematics attitude is now viewed as a multidimensional phenomenon (Sandman, 1980). Contemporary usage of attitude in psychology entails several components- affective (emotional tone or feeling), cognitive (consciously held belief), and conative (disposition for action) (Reber, 1985). In this study, attitude refers to affective responses that involve positive or negative feelings of moderate, intense and reasonable stability of liking or disliking.

Research on attitudes toward mathematics has a relatively long history(Shaughnessy, Haladyna & Shaughnessy, 1983; Reyes, 1984). McLeod (1992) argued that attitudes toward mathematics develop in two distinct ways. First, students may assign an attitude that has been attached to a previous memory schema (e. g. geometry) to a new schema (e. g. algebra). Second, negative or positive attitudes may be based on a series of repeated emotional reactions to a set of mathematics tasks. In short, attitude may be seen as quasi-automatic reactions to a subject-matter domain. Literature shows that younger children through elementary years have quite a positive attitude toward mathematics but later on begin to feel mathematics is a hard subject (Stodolsky, 1985).

Stability of attitudes in elementary years is, however, doubted. There is evidence that attitudes toward mathematics may be formed as early as third grade (Aiken, 1970), and they tend to be more positive than negative. Studies have also shown that 4th-6th grades can be very influential in forming attitudes (Aiken, 1970). This could be because mathematics at the elementary level still lacks complex, abstract problems which allows students to do well and make them like mathematics. Other studies have reported that students have indicated that they develop attitudes throughout school. Attitude formation at this level could be due to increasing social sophistication the students begin to experience, and/or their willingness to learn mathematics because they have been told mathematics is influential in their lives. Dickinson (1990), Sijde and Tomic (1992) and Skemp (1976) claim that the widespread failure by teachers to teach "relational" mathematics is the major cause of negative attitudes toward mathematics and the rejection of mathematics by many students and even teachers, a situation which is surely a real danger to our society.

Researchers have hypothesized that attitudes toward mathematics contribute to gender differences in mathematics problem solving (Brush, 1985; Joffe, 1988). The underrepresentation of females in mathematics and other related fields is partly caused by negative attitudes (Clewell, Anderson & Thorpe, 1992). The negative attitudes are also due to poor academic performance (Dossey et al., 1988), and lack of confidence in their mathematics ability (Tobin, 1987). Females are more likely than males to attribute their difficulty in mathematics to their own situational and external factors (Dweck, 1986). Mathematics is perceived as a high-order discipline and male teachers usually perceive females as low achievers. The instructional strategies and materials used in most mathematics classes tend not to complement learning styles of females (Meece et al., 1982). In another study among gifted girls, Lamb and Daniels (1993) found significant differences in five of the six subscales in mathematics attitude inventory.

Research has found significant differences in attitudes toward mathematics between males and females especially in Junior High (Fennema & Sherman, 1977). The lack of positive attitudes and lower achievement in females has been attributed to stereotyping expectation of parents, peers and teachers rather than lack of ability. More recently, Kerr (1988) contended that females are rewarded for intellectual achievement at early ages but by adolescence, they are rewarded for social conformity, which may include seeing mathematics as masculine. Kerr (1988) asserted that stereotypical expectations placed on girls relative to mathematics involvement were influencing factors. The gifted girls, especially in rural areas, may be more influenced by social conformity which affects their attitudes toward mathematics due to cultural dominance of the community. These adverse attitudes toward mathematics may also limit their occupational choices because of lack of mathematical ability to tackle mathematics-related jobs. Sherman (1980), in a study of children in grades 6 to 10, reported that both boys and girls tended to view mathematics as a male domain.

Achievement in Mathematics

A coherent body of research about student achievement has emerged. The research findings identify a number of teacher variables that affect students' achievement (Berliner, 1983; Purkey & Smith, 1983; Rosenshine & Berliner, 1978). Berliner identified instructional content choices as a primary planning decision that affects student achievement.

Level of instruction relative to the ability level of the student is an important relationship that should be considered in ensuring that optimal learning will result. The probability of success on a particular task increases in direct proportion to the match between the difficulty level of the task and the ability level of the student (Blair, 1984). Significant skill development will be difficult to attain if students are instructed at levels that are much higher than their ability levels (Blair, 1984). Likewise, little will be gained if students are instructed at levels that are much lower than their ability levels. Teachers who introduce skills, ideas and procedures with difficulty level commensurate with student abilities are practicing one of the basics of effective instruction. In addition, teachers who provide practice on skills that are at the appropriate difficulty level for students increase the likelihood of students' mastery of those skills (Blair, 1984).

There is an abundance of evidence indicating that the amount of time that children are exposed to an instruction program will have positive effect on achievement. Moreover, the time allotted to particular content areas is causally related to the development of those areas (Berliner, 1983). Amount of exposure to an instructional program may be defined in different ways, one of which is the amount of time allocated for direct instruction; another is academic learning time (i. e. time students spend engaged in activities of an appropriate difficulty level) (Berliner, 1983). Students who spend a large proportion of time in learning activities designed to enhance skill knowledge are more likely to attain those skills than students who spend less time in these activities (Rosenshine & Berliner, 1978).

A major factor also affecting achievement in mathematics is the method of instruction employed by a teacher. Njobe (1989) has documented that most mathematics lessons are dominated by rote memory (drill) strategies, repetition of meaningless expressions, terminology and symbols. This leads to a lack of mathematics understanding and logical reasoning ability.

Teacher effectiveness research has examined the effects of both teacher's background and quality, and other psychological environments (age, sex, education, teaching experience) and found them to have significant effects on student achievement (Reynolds & Walberg, 1992). Majority of studies on teachers' social background revealed significant effects within primary schools (Heyneman & Loxley,1983). Another study found formal education and post secondary training to be associated with achievement in Columbian and Zimbabwean schools (Nyangura & Riddell, 1992; Ross & Postlethwaite, 1992). However, the general background and preservice training of teachers rarely help to explain variation in children's achievements in the United States and Europe (Hanushek, 1992; Harbison & Hanushek, 1992).

Other factors like family background have also been reported to influence achievement in mathematics. White (1982) found that SES (income, occupation of parents, education) was significantly correlated with academic achievement. In his early study in Uganda, Heyneman (1979) found no relationship between SES and academic achievement in Primary Leaving Examinations (PLE) but when the P.L.E was broken into parts, there existed consistent statistically significant relationship with performances in English, but not mathematics and social studies.

Gender differences in achievement in mathematics have been reported in many studies (e.g. Eccles, Addler, Futterman, Goff, Kaczala, Meece & Midgley, 1983). Research indicates that males out perform females in mathematics achievement at Junior High (Fennema & Sherman, 1977). Boswell and Katz (1980) found that girls who had deficiency in school mathematics in Junior high became weaker in secondary school mathematics and did not have appropriate background to enter technical fields of study in universities and colleges although the women were generally found to seek help more than men. In contrast, Cherian's (1993) study of Xhosa children in S. Africa reported no significant effect of gender on mathematics achievement.

Recently, Holloway, Fuller, Hess, Azuma, Kashiwagi & Gorman (1990) found that for girls, SES was a significant predictor of mathematics achievement. Cherian (1993), in his study among the Xhosa children, a significant effect of SES on mathematics achievement. However, White's meta-analysis of 101 studies revealed that the relationship between SES and academic achievement is much weaker. Boulton-Lewis, Neill and Halford (cited in Clarkson, 1991) in a study of the Koori people of Australia suggested two main reasons for poor mathematical achievement by the Koori children: lack of perceived relevance to everyday life by children and their parents, and inaccurate English used by teachers.

A study by Benbow and Stanley (1983) reported that mathematical abilities show gender difference, with males performing better than females from adolescence onward. At the very highest levels of mathematics achievement, men outnumber women by more than 10 to 1. However, Hyde, Fennema and Lamon (1990) cautioned that the gender difference in mathematics is not apparent in early childhood, but appears in adolescence and usually favors boys in tasks involving high cognitive complexity (problem solving) and favors girls in tasks of less complexity (computation). Even among mathematically gifted boys and girls, gender differences have been reported. Benbow and Stanley (1983) using 49747 intellectually talented students, found more boys than girls (those who were 12 yrs old) scored higher on scholastic aptitude test (SAT) even though the girls were matched for abilities, age and grade.

Factors related to girls' underachievement in mathematics may be more than attitudes. Meece et al. (1982) reported that such factors may include innate differences in ability or aptitude, cognitive factors (e.g. IQ., attention, processing and memory levels), affective & motivational factors (such as role modeling or stereotyping mathematics as a male domain), and mathematics anxiety (e.g. panic, helplessness).In most cases, men have superior talent. For the girls, constant interaction with mothers who have little knowledge of mathematics and which may affect their self efficacy expectations can not be ruled out (Njobe, 1989).

Other factors include, for example, age of students, instructional styles teachers use, and learning environment. Age of children has also been documented to be another factor that may influence achievement in mathematics. Brush (1985) has noted that differences in achievement tend to increase in upper secondary level and it is pervasive across cultures. Confidence in mathematics for girls has been reported to deteriorate significantly between the ages of 13 and 15.

Another significant factor influencing achievement is level of ability of children. Low ability students (low achievers) perform very poorly in mathematics because they have virtually no idea of what they should do when they confront a mathematics problem and they often are unable to explain the strategies they use to reach a solution (Sternberg, 1986). Low achievers evidence poorer planning and memory on school tasks, are less flexible in reorganizing the tasks, and could be said to be at lower language developmental level. Such deficient language development could be a critical factor in poor organization of skills (Vygotsky, 1978; Luria, 1976). By contrast, those who perform well are those who possess well developed metacognitive skills because they are aware, can plan, and have good memory. Metacognition is an aspect of critical thinking that includes students' abilities to develop a logical strategy during problem solving (Baron & Sternberg, 1987; Schoenfeld, 1987).

School characteristics or organization (school climate and culture, classroom climate and size) are another factor that may influence students' achievement. McKnight, Crosswhite, Dossey et al. (1987) noted that in the United States, teachers face bureaucratic workload such as teaching 5 classes daily and spending about 23 hours per week teaching. This work load is more than for teachers in other countries. In contrast, Japanese teachers handled only three to four classes a day and taught about 16 to 17 hours per week and their meetings focused on improving instruction other than being dominated by administrative issues. Heyneman & Loxley (1983) found that variance in student achievement explained by school characteristics amounted to 16% across 17 developing countries. Mayer, Tajika and Stanley (1991) found that students in the United States perform below their cohorts in Japan on mathematics achievement tests (computational skills and problem solving). These differences are due to the kind of exposure to mathematics.

Length of school year and instructional time have been found to relate to achievement. Japan, which ranked first and second in several assessments, has the longest school year (243 days) while the United States year has an average of 180 days. But it was also noted that Japan spends much of the time on extra curricula and ceremonial activities rather than on formal instruction (Feiler, 1991). Amount of time students spent listening to teachers lecturing (active pedagogy & classroom processes) was positively related to achievement in Nigeria (Lockhead & Komenan, 1989) but Keeves and Mueller (1992) commented that the amount of time appears largely unrelated to achievement although some effects were observed in science.

Frequent questions posed by teachers were positively associated with mathematics achievement in Nigeria (Lockhead & Komenan, 1989). Less didactic and more active forms of pedagogy were positively related to science and mathematics achievement in the Phillippines (Lockhead & Zaho, 1993). However, influence of pedagogical practices may depend on a particular subject because different subjects can be taught more effectively through different strategies. In Botswana, for instance, the number of open questions asked by teachers was negatively related to mathematics achievement but not to English (Fuller & Heyneman, 1989).

Exposure to mass media outside school (e.g. radio, TV, newspapers, social activities) also promotes achievement (Reynolds & Walberg, 1992). Curriculum-centered models are limited by being school based, yet many critical influences on learning lie outside of the schools (Feiler, 1991; Stedman, 1993b).

Relationships Between Attitudes Toward Mathematics and Achievement in Mathematics

Attitude appears to have modest influence on achievement in mathematics. Research shows that along with positive growth in mathematics achievement, attitudes toward mathematics are highly important outcomes of mathematics instruction and often play a major role in student decision-making. It is commonly believed by educators that positive attitude to school learning promotes school progress and attainment (Norwich & Jaeger, 1989) and yet research has consistently found weak relationships between attitudes and educational attainment. These relationships have been studied in the areas of mathematics and science education. Norwich and Duncan (1990) and Norwich and Jaeger (1989) reviewed these studies and found no direct causal relationships, have had inconsistent findings and at best have found only low to medium correlations. Similar results were reported by Gorman (1987) and Joffe (1987).

Attitudes are believed to affect academic performance in some way. In fact, the influence might be reciprocal in that attitude affects achievement and achievement, too, affects attitudes (Aiken, 1970). Many researchers studying mathematics have hypothesized that a positive attitude contributes meaningfully to higher achievement. Aiken (1970) noted that "correlations between attitude and achievement in elementary schools, though statistically significant in certain instances, are typically not very large" (p. 559). For example, Neale (1969) reviewed three studies concerning mathematics attitudes and achievement that were conducted between 1967 and 1968. He noted positive correlations in each study between .20 and .40.

Robinson (1975) also reviewed studies and suggested that a causal relationship between mathematics achievement and mathematics attitude may not exist. But, Dossey, Lindquist, Mullis and Chambers (1988) found that there is a positive correlation between attitude and achievement at grade levels (3, 7, and 11) but the percentage of those who say they enjoy mathematics declines from 60% in grade 3 to 50% in grade 11. Similarly, Hackett and Betz (1989) reported that mathematics performance and achievement were significant and positively correlated with attitude toward mathematics. A meta analysis of studies have reported positive but moderate relationships between attitudes and achievements in mathematics (Schibecci, 1984). However, a number of studies point to persistence of negative attitudes as students ascend the academic ladder due to the complex, abstract components of mathematics (e.g. algebra, probability, statistics). Research by McLeod (1992) suggests that neither attitude nor achievement is dependent on the other; rather, they interact with each other in a complex and unpredictable ways. For example, a study indicates that Japanese students have greater dislike for mathematics than students in other countries even though Japanese achievement was very high (McKnight et al, 1987).

Schoenfeld (1985) found that correlation between mathematics attitudes and achievement for girls ranged from -.16 to .24 but found somewhat more consistent positive relationship for boys with correlation ranging from -.11 to .45. Even boys with negative attitudes, who possess ability, would perform poorly and avoid mathematics related subjects. This finding indicates the fundamental influence of attitude toward mathematics on achievement and future scientific and technological development.

Armstrong (1979) and Boswell and Katz (1980) reported that sex differences in mathematics achievement were not due to ability but some attitudinal factors. There is growing literature suggesting that children's achievement is related to attitudes held by children, teachers and parents. This difference has been found to be true in studies of children in the United States (Eccles et al., 1983; Parsons, Kaczala & Meece, 1982) and in comparative studies involving children in Japan, Taiwan and the United States of America (Holloway & Hess, 1985; Lee, Ichikawa, & Stevenson, 1987).

Stevenson, Lee and Stigler (1990), in their study in the United States, articulated that American children's lower level of achievement in mathematics cannot be explained in terms of attitudes. The majority of the American children liked mathematics, thought they were doing well in mathematics, and wished to learn more about mathematics. American children hold favorable attitudes about mathematics but their lower performance suggests that these positive attitudes were not derived from a clear understanding of mathematics or an appreciation of mathematics complexities. Rather, they believed mathematics was easy and they were doing well, and they were supported by their parents.

A report on a number of studies by Clewell, Anderson and Thorpe (1992) noted that one of the principal barriers to minority and female success in mathematics and science, particularly after the early elementary grades, is attitude. Factors contributing to this negative attitude included: poor self-concept as a student of mathematics, negative perception of the utility of these subjects, stereotyping as white or male activities, and discouraging influences of significant others including teachers and parents because mathematics becomes decontextualized and abstract for females.

In a study by Dwinell and Higbee, 1991), affective variables together accounted for 34% of the variance in mathematics grades with anxiety as the only attitudinal variable that made a significant contribution to the proportion of variance (27%). Similarly, a significant relationship was found between attitude toward mathematics and achievement in grade 3 (Cain-Caston,1993). In support, Tocci and Engelhard (1991) reported that achievement creates a significant main effect on attitudes toward mathematics. Meanwhile, Norwich and Rovoli (1993) noted that attitude is not a very good predictor of behavior intention.

There is at best explicit or implicit assumption that attitudes to school and school subjects should be related to achievement, only on the grounds that positive attitudes lead to greater achievement. Affective factors should be treated as both entry and outcome factors (Bloom, 1976) and analysis should be beyond bivariate correlations. The differences in students' attitudes toward mathematics and their achievement in mathematics may be attributed to differences in teacher practices in the classroom.

Summary of Students' Attitudes Towards Mathematics and Achievement

Attitude seems to affect the teaching and learning of mathematics. Differences in mathematics attitude exist due to many factors such as gender. Achievement differences in mathematics also exist due to many factors. Attitudes might inluence achievement or vice versa. From all these studies, it appears that correlations of mathematics attitudes with achievement in mathematics, attitude i considered to be an important moderator variable between teaching and student achievement.

Differences Among Teachers' Classroom Practices

Philosophies of Teaching

Paradigms of knowledge and instruction. Teaching is the process of disseminating knowledge and skills to learners (Farhnam-Diggory, 1994). Effective teaching is creating classroom behavior that promotes enthusiastic student involvement in the learning activities that minimize disruptive student behavior and make efficient use of instructional time. Effective teaching should promote positive learning for students (motivation) and professional satisfaction for teachers (Miller & Lieberman, 1990).

Much of the blame for students' poor performance in mathematics and science can arguably be attributed to how we teach these subjects. For most parts, the instructors emphasize factual and procedural knowledge at the expense of conceptual understanding (Stake & Easley, 1978). This is not unique to mathematics and science but is consistent with the whole approach in education (Cohen ,1988). A teacher can enable children to understand mathematics by providing a stimulating instructional environment in which learners are motivated to learn.

A primary expectation of mathematics and science students in today's schools is that they learn essential knowledge and skills and that they should be able to transfer these skills and knowledge to related, more complex learning or real life situations. This theoretical perspective emphasizes the importance of all types of knowledge in mathematics (Farhnam-Diggory, 1994). Five types of knowledge may be acquired: Declarative knowledge (e. g. mathematics notation), procedural or intellectual knowledge (action sequence-must be demonstrated e.g construction), conceptual knowledge (categories and schemata), analogical (images) knowledge (preserves specific correspondences between what is outside in the world and what is inside), and logical knowledge (system of causal implications- a mental model of what is connected to what and what leads to what). All the five types of knowledge should be essential in mathematics teaching and learning

(Farnham-Diggory, 1994).

Psychological research suggests that although procedural skills and conceptual knowledge are likely to influence one another from an instructional perspective, their acquisition probably require different forms of instruction (Novick, 1992, cited in Geary,1995). Research suggests that deep conceptual understanding of mathematical domain requires a lot of experience but does not appear to require drill and practice (Geary, 1995). Conceptual knowledge reflects the child's understanding of the basic principles of the domain. Current educational philosophy focuses on the acquisition of conceptual knowledge and often deems the acquisition of procedural skills as unnecessary and even detrimental to children's mathematical development (Cobb et al, 1992, cited in Geary, 1995; Althouse, 1994).

A framework of how children learn mathematics and how we can most effectively help children learn mathematics suggests that teachers develop their goals in a developmental approach (Van de Walle, 1990). This goal consists of helping children develop (a) conceptual knowledge of mathematics (e.g. 3/4 and 9/12 are the same), (b) procedural or mechanical knowledge of mathematics (i. e. process that can be used in one fraction to get the other such as multiplying the numerator and denominator by 3), and (c) connections between conceptual and procedural knowledge.

Epistemology of mathematics instruction. Mathematics has emerged as a prime topic in cognitive psychology of instruction because of its importance in the school curriculum and in economic development. Mathematics is a major part of the elementary school curriculum, both in Uganda and other parts of the world. A fundamental goal of mathematics instruction in the elementary grades is to equip students with basic skills to solve quantifiable problems. Research has shown that, unfortunately, too many students in the elementary grades fail to acquire sufficient skills in the operations and applications of mathematics. The problem is severe for low achieving students (Kameenui & Simons, 1990).

Skemp (1971) has suggested two principles of teaching mathematics. The most fundamental is that teachers' goals should be to provide experiences that lead children to progress from a concrete intuitive level of learning dependent on the teacher toward a more symbolic level of learning independent of the teacher. This idea of symbolic learning supports the view that learners should be taught to understand mathematics. Understanding occurs if the concept being taught is part of an internal network, that is its mental representation is part of a network of representation (Hiebert & Carpenter, 1992). Understanding promotes remembering (Bruner, 1960), reduces the amount that must be remembered, enhances transfer (Brown, Bransford, Ferrara & Campione, 1989) and influences beliefs (Doyle, 1983).

Bloom's taxonomy (cognitive domain) of educational objectives (1956) is a useful guide to help mathematics teachers conceptualize. The taxonomy is a hierarchy divided into six levels of increasing complexity from knowledge to evaluation:

1. Knowledge - involves recall of information (e.g. reciting numbers in correct order);
2. Comprehension - involves recall of concepts, translation or interpretation and extrapolation of information (i. e demonstrating understanding of concepts and their relationships, not solutions e.g. one to one correspondence);
3. Application - involves using skills and concepts in new situations (e.g. construct a one to one match between odd numbers and their multiples);
4. Analysis - involves seeing relationships, making comparisons and contrasts, and looking for patterns (i.e. break down whole entities into component parts);
5. Synthesis - involves pulling together or combining elements (i.e. putting ideas together); and
6. Evaluation - involves determining the worth of the problem.

Teaching mathematics requires the teacher to be knowledgeable in both mathematics and psychology because organizational skills are required (Cruikshank, & Sheffield, 1988) and when many children are collected together for instruction, a variety of learning styles present a formidable challenge to the teacher. Prospective mathematics teachers, at any level, should know and understand mathematics substantively beyond that which they may be expected to teach to be able to relate that mathematics to the world of the pupils, to natural and social science. This view lends support to Brownell (1935), an early mathematics educator, who in his 'meaning theory' called for 'instructional reorganization' so that arithmetic (mathematics) would be "... less a challenge to pupils' memory and more to their intelligence".

In the broadest sense, learning mathematics serves both as a means and an end. Learning mathematics is a means of developing logical and quantitative thinking abilities. It is an end when children have acquired and developed basic computational skill and can apply mathematics to their world (i.e. when mathematics becomes functional to their lives) (Cruikshank & Sheffield, 1988). Research findings suggest that mathematics instruction should help to enrich, deepen, and widen students' problem solving abilities (Cooper,1984; Cooper & Robinson, 1991).

Cognitive paradigms in mathematics education. Cognitive theorists like Piaget (1971), Bruner (1966) and Vygotsky (1978) articulate that children should be allowed to experiment physically with things around them. Children learn better if "pictorial-symbolic modes" are employed in teaching. Piaget's theory of intellectual development provides some important implications for teaching and development. Piaget asserts that as children interact with their social and physical environment, their mental growth progresses through four qualitatively distinct stages: the sensori-motor stage (0-2 yrs.), pre-operational stage (2-7 yrs.), concrete operational stage (7-12 yrs.), and the formal operational stage (12+). The most important single proposition that a teacher can derive from Piaget's work is that most children learn best from concrete activities (Ginsburg & Opper, 1969). This proposition, if implemented in schools, would substantially alter the role of the teacher and nature of the learning environment. The teacher would become less of an expositor and more of a facilitator (i.e one who promotes and guides children's learning rather than teaching everything directly).

Although Piaget did not derive from the theory guidelines for helping children learn mathematics, many educators have interpreted his work to generate substantial implications for teaching mathematics: (a) Children who are in the pre-operational or concrete stages should be given ample opportunity to learn mathematics by doing (manipulating real objects). This learning by doing enables children to acquire mental imagery needed to build up understanding of mathematical concepts and to be able to work with them later on an abstract level (Fuys & Tischer, 1979) ; (b) There should be active engagement in the lesson because children at different ages have different ways of looking at the world and learn from what they experience (Fuys & Tischer, 1979); and (c) Children can be involved in inventing mathematics.

The central mechanism for learning is "transfer of responsibility" (Rogoff & Gardner, 1984) for reaching the current goal, whatever that goal may be. The venue for this transfer is Vygotsky's zone of proximal development (ZPD) which refers to tasks the child is initially able to do only with the teacher and peers, but can later do independently. The lower limit of ZPD is the level of problem solving achieved by the child when working independently, and the upper limit is the level of additional responsibility the child can currently accept with the assistance of an able instructor.

Research shows that during the early stage of learning, mathematics is liked and enjoyed by the majority of elementary school children. Later, some begin to develop mathematics anxiety (reluctance and fear to engage in mathematics) and may consequently become totally dysfunctional in mathematics (Hatfield, Edwards, & Bitter, 1993; Suydam, 1984). This shift could occur because many mathematics teachers who were trained sometime ago are characterized by traditional views of learning (absorption theory) which view children as passive learners who merely store knowledge.

To avoid such negative experiences, Suydam (1984) advises that teachers should:

1. endeavor to make mathematics enjoyable so that children develop the perceptions of mathematics and of themselves in relation to mathematics,
2. show that mathematics is useful in both careers and everyday life,
3. adapt instructions to students' interests and ability and show that mathematics is understandable by employing meaningful methods of teaching, and
4. provide experiences designed to help children be successful in mathematics.

Similar ideas were articulated by Burger & Shaughnessy (1986), Copeland (1984) and Ginsburg (1983) when they advised that learning of mathematics should be devoid of boredom, meaninglessness, and coersion.

Teaching Strategies in Mathematics

Some teachers are deeply committed to teaching while others are not. Teaching mathematics is a complex process in which the teacher is required to weave together knowledge from different aspects of mathematics like arithmetic, geometry, algebra and statistics (NCTM, 1991; Resnick, 1987). Mathematics instruction should adopt broader goals for all students. It must provide experiences that encourage and enable students to value mathematics, gain confidence in their mathematics ability, become mathematics problem solvers, and reason and communicate mathematically.

In Nigeria, despite the constant appeal by the Ministry of Education, most teachers preferred lectures (Odubunmi, 1986; Olarewaju, 1982). Results from these studies have suggested that most teachers did not bother and care to use effective strategies. Odubunmi & Balogun (1991) found that the lecture method was inferior to strategic methods, which had significant effects on cognitive achievement of students. There is considerable evidence that student-learning and teaching techniques (strategies), such as cooperative approach, are effective for increasing social interactions and mutual concern (Sharan, 1980; Slavin, 1980). There is, however, still much debate about their merit as a means of developing cognitive skills.

Numerous studies have described the learner and the manner in which learning can be enhanced. Behavioral theories have portrayed the learner as a passive recipient in the teaching-learning process, others have contended that children must be actively involved, both mentally and physically Schunk, 1989). Some theories have depicted the role of the teacher as the prime expositor of knowledge, as the person primarily responsible for children's learning (Post, 1988). Other theorists view the role of the teacher primarily as a guide or facilitator of learning, one who effectively organizes the conditions under which the learning can take place and then exposes children to those conditions (Post, 1988).

Dienes (1960) expressed concern with many aspects of the status quo in mathematics including the restricted nature of mathematics, content taught, narrow focus of program objective, and limited nature of instructional methodology. Hence, he postulated a theory of mathematics teaching and learning which has four basic components or principles:

1. Dynamic Principle, which suggests that the understanding of a new concept is an evolutionary process involving the learner;
2. Perceptual variability Principle, which suggests that conceptual learning is maximized when children are exposed to a concept through a variety of physical contexts or embodiments;
3. Mathematical variability Principle, which suggests that a generalization of a mathematical concept is enriched when variables irrelevant to that concept are systematically varied while keeping the relevant variables constant; and
4. Constructivity Principle, which suggests that there are two kinds of thinkers; constructive and analytical.

The unifying theme of these four principles is undoubtedly that of stressing the importance of learning mathematics by direct interaction with the environment. Therefore, whole-class or large group teaching should be de-emphasized in order to accommodate individual differences in ability and interest. Research supports the use of a variety of teaching strategies because different students respond differently to various ways of teaching (Post, 1988; Orlich, Kauchak, Harder et al., 1980). Research has documented that when students' learning styles are congruent with complementary teaching strategies, increased academic achievement is evidenced (Adam,1983; Cafferty, 1980; Mehdikani, 1980).

There is general agreement that to develop capable learners and thinkers, teachers need to rely on more than rote memory, factual knowledge, and routine of application of familiar procedures (Baron & Sternberg, 1987; Coles & Robinson, 1989; Fisher, 1990; Glaser, 1984; Nickerson, 1988; Resnick, 1987; Resnick & Klopfer, 1989). Mcknight et al (1987) noted that in the United States, mathematics teaching is dominated by "vulgar formalism" approaches that encourage rote and text book oriented learning, hence poor performance in mathematics. In contrast, Japanese mathematics teachers use socrative teaching methods and their students perform well in mathematics (Stigler & Stevenson, 1991). Rote teaching could also explain why many countries have performed at disappointing levels in mathematics assessment (Stedman, 1994).

Cognitively-Oriented Strategies in Mathematics:

There is presently a great interest in cognitive theory and its application in the classroom. This interest has, in turn, generated a score of cognitive teaching techniques called "cognitively-oriented instruction" (Idol & Jones, 1991; Roth, 1990; Sawyer, Graham, & Harris, 1992). COS refers to teaching for higher-order thinking in mathematics. The approach regards mathematics as more of a conceptual (idea-based, higher-order) than a rule-governed domain and aims at helping students acquire skills and knowledge cognitively (Pressley, 1986). This approach, which is regarded as student or process oriented, includes efforts to help students construct meaning from texts, solve problems, select and develop effective thinking strategies, and has students who take responsibility for their own learning, and has as its focus transfer of skills and concepts to new situations (Jones, Palinscar, Ogle & Carr, 1987; Ornstein, 1995). The delivery strategy involves providing instruction using activities and manipulatives in conjunction with verbal cues.

The philosophical core of cognitively-oriented strategies (COS) contrasts sharply with the behavioral approach. COS approaches emphasize the importance of developing and integrating a repertoire of cognitive and metacognitive strategies (Brown, Campione & Day, 1981; Weinstein & Mayer, 1986). The essential features of COS are: First, they require the learner to engage in two distinct and successive activities that involve verbal associations, concepts, and rule relationships. Second, they require the learner to have complete knowledge of the component skills. In COS, students are no longer regarded as empty vessels to be filled with knowledge but as active "apprentice learners" (Collins, Brown & Newman, 1989) who benefit from participation in goal oriented collaborative activities.

Cognitively oriented strategies have the potential to substantially alter the learning capability of children especially low-achieving children (Resnick, 1987). Both, students who possess high cognitive and low cognitive structures, can learn effectively with this strategies. The strategies facilitate the development of critical and reflective thinking, reasoning skills and abilities, and attitudes towards mathematics. Children who undergo thinking instruction in mathematics generally score better on outcome measures than those presented with content mainly (Chance, 1986; Nickerson, 1984; Nickerson, Perkins & Smith, 1985; Sternberg & Kastoor, 1986).

Smith (1977) who studied college classrooms found critical thinking to be related to teacher support, teacher questioning, and peer interaction. Redfield and Rousseau (1981) advocated that higher cognitive questioning yields higher student achievement. The literature on thinking suggests that learning can be significantly improved by appropriate instruction that:

1. builds on students' existing knowledge base,
2. extends learners' repertoire of cognitive and metacognitive strategies,
3. corrects specific learning problems (Borkowski, Carr, Rellinger & Pressley, 1990; Paris & Winograd, 1990; Pressley, Wolosyhn, Lysynchuk, Martin, Wood & Willoughby, 1990; Weinstein & Mayer, 1986).

According to McTighe and Schollenberger (1985), arguments that can be used to justify the use of cognitively oriented strategies instruction include:

1. Learning and thinking skills are necessary to acquire and process information within an ever expanding field of knowledge.
2. Solutions to significant problems in our modern world require qualitative improvement in thinking and understanding.
3. Learning only testable fact finding skills will prove inadequate for life in the modern world. Higher-level thought processes will be needed to function effectively.
4. Democratic society needs reflective and critical citizens (Good & Brophy, 1991; Slavin, 1991).

Cognitively oriented strategies of instruction have recently and mistakenly been described as failing to be constructivist in nature and should be abandoned (Kronick, 1988). Some researchers characterize cognitive strategy instruction as involving little more than telling children what to do and expecting them to memorize and produce the steps of a strategy. Students should work on highly controlled skills they don't understand.

Many cognitively based strategies can be used to help students acquire thinking skills such as association, chunking, brain storming and higher-order thinking skills. However, they vary considerably in the degree of specificity or generality they possess. Some appear to be highly specific to the task being undertaken (Gagne, 1985). The role of the teacher is to select strategies and skills to be learned and the learner's role is to develop a repertoire of strategies and skills. The possible approaches that can be employed include: metacognitive, cooperative, discovery, and laboratory techniques.

The problem-solving approach. This approach focuses largely on teaching basic problem solving skills, and provides a more realistic motivational context in which specific problem solving techniques can be taught so as to help learners apply mathematics to practical daily problem-solving situations (Brophy, 1989; Helmer & Trueblood, 1977). The use of the problem solving approach in mathematics demands not only extensive preparation but also the development of ways to maintain at least a medium of classroom control and perhaps the ability to envision goals of teaching. The technique may not, however, guarantee solutions to problems but may serve as a guide in the problem-solving process (Brown, Collins & Duguid, 1989; Greeno, 1980; Mayer, 1983).

The metacognitive approach. This technique is an aspect of critical thinking that can be experienced through peer teaching, brainstorming, and consensus building. The technique helps to facilitate self-appraisal and self-regulation of learners' beliefs, judgments, attitudes and self concepts (Paris & Winograd, 1990; Pressley, Borkowski, 1987; Borkowski, & Schneider, 1987). Students can learn skills of how to represent problems and how to devise and monitor solution plans (Gardner, 1983; Sternberg, 1986). The metacognitive approach emphasizes the problem solving process rather than the generation of correct answers (Scohenfeld, 1985).

The metacognitive approach suggests helping lower aptitude students to acquire prerequisite knowledge they need to benefit from meaningful methods of instruction (Snow & Lohman, 1984). The approach recognizes that students come to learning situations with existing knowledge and skills that may affect their learning of new knowledge (Case, 1985). The metacognitive approach proposes that teaching should be contextualized, that is teaching should be conducted within the context of subject matter tasks that have meaning for students.

A great deal of research supports the importance of metacognitive teaching strategy in cognitive development and academic learning (Pressley, Borkowski & O'Sullivan, 1985). The approach helps learners to become active participants rather than passive recipients of instruction and imposed experiences (Paris & Byrnes, 1989). The approach can empower the learner with personal appraisal and management, and it is oriented toward analysis of individual differences and cognitive development and learning. It is embedded in cognitive development and represents the kind of knowledge and executive abilities that develop with experience and schooling. The approach provides learners with knowledge and confidence that enables them to manage their own learning and empowers them to be inquisitive in their pursuit (Paris & Byrnes, 1989).

The discovery approach. Discovery or inductive is the inquiry technique in which the teacher delays the verbalization of concepts until the end of the instructional sequence in which that concept is to be taught (Henson, 1993). Children are guided to inductively acquire some of the information in an independent manner. The technique is intended to enable the learner to discover or construct principles by interacting with instances of these principles (Henson, 1993).

The essential feature of the discovery technique is therefore that content is not given but is discovered by the learner before it can be integrated with already existing knowledge. Children who discover a new idea learn more than the idea itself; learn something about how to learn; learn heuristics of how to solve problems; learn processes of analysis, synthesis, and evaluation, which are higher order cognitive domain skills and acquire competence, which will be invaluable tool for life long learning (Helmer & Trueblood, 1977).

Various researches attest to the superiority of the discovery approach (Worthen, 1968). Many mathematics programs stress discovery approaches because these techniques increase the students' ability to learn mathematics. Researchers like Worthen (1968) contend that the discovery technique enhances retention and transfer of mathematical concepts, builds motivation, and leads learners to be constructive However, other researchers (e.g. Henson, 1993) observed no significant difference between discovery and other approaches. In using the discovery strategy, little subject matter may be discovered (Henson, 1993). The technique requires increased expenditure of money and time, causes frustration when children fail to discover and it is not equally appropriate for all children (Worthen, 1968).

The cooperative technique. Cooperative approach is known by different names such as collaborative, collective, reciprocal, team or peer teaching. It is an instructional technique in which students work together in small, mixed ability or heterogeneous groups (two to six) on learning tasks assigned to them. Activities typically require collaboration and mutual support (Davis, 1993; Guskey, 1987; Jules, 1990; Ornstein, 1995). The technique is a means of promoting higher level thinking skills and problem solving (e.g.Johnson, Johnson, Holubec & Roy, 1984; Parker, 1984). The technique capitalizes on the power of peer relationships and can help to develop positive attitudes to mathematics and increase confidence to do mathematics.

The cooperative approach seeks to minimize student anxiety and competition by creating an environment where students feel safe to make and learn from mistakes (Parker, 1984). Students get the opportunity to speak aloud, to challenge and defend a point of view, and to focus on the problem solving process rather than the answer (Parker, 1984). Research has documented that cooperative learning produces high mathematics achievement in computation and academic skills, and builds motivation within students' social and affective development (Brophy, 1986; Parker, 1985; Slavin, 1984).

Educators advocate for classrooms where students have a sense of control over their environment and power to aid their own learning through cooperative learning because everyone contributes to the success of everybody in the group. Working closely together tends to foster understanding and can lessen prejudice (Johnson & Johnson, 1987, 1989;

Kagan, 1989; Slavin,1986) because it fosters positive interdependence (i.e. each student is responsible for one's own learning and that of others in the group), individual accountability (i.e. each student must demonstrate mastery of the task); interaction (i.e. there is opportunity to explain what they are learning to each other and help each other); social skills (i.e. communicate, provide leadership, build and maintain trust and constructively resolve conflicts); and group processing (i.e. periodic assessment of how well they are working together and how to improve their effectiveness).

Typically, in the cooperative approach, students can serve as a major learning resource for each other, gathering and sharing information as needed. The teacher acts as a consultant and coordinator. Slavin (1984) asserts that the reason for the success of cooperative instructional approach is that by rewarding groups as well as individuals, peer norms come to favor rather than oppose achievement. Results from a meta-analysis of cooperative teaching research indicates that cooperative approaches have been successful in promoting increased academic achievement (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). Despite results from a large number of studies, controversy still exists about the effects of a cooperative approach because of lack of systematic corrective feedback from the teacher, because the ideas depend on individual groups.

The laboratory technique. The laboratory technique is the practical mode of teaching mathematics that involves exposing learners to discover mathematical concepts through exploration with materials such as the dice, blocks, abaci or balances (Copeland,1984). This approach facilitates learning by doing and Piaget argues that this mode is appropriate for mental development (Copeland, 1984) although Cangelosi (1992) asserts that the method is not as effective as people may think.

In summary, teachers can select and use a variety of cognitively oriented strategies to teach mathematics which are believed to be more effective than the content oriented strategies.

Content-Oriented Instruction

Content-oriented instruction (COI), also known as teacher-centered, active teaching, or structured method, is the traditional technique that is still extensively used in teaching (Ornstein, 1995). The technique focuses heavily on teaching facts, rules and sequences in which the teacher is the major provider or producer of knowledge through verbal means (Ausubel, 1961; Ornstein, 1995). The technique is subject-centered and regards mathematics as procedural (rule-based, lower-level) in which the teacher's role is to impart those facts, rules, actions, and sequences to students through verbal lecture and chalk. This approach may consist of giving information, explanations, citing examples, giving opportunities for practice and feedback and checking for pupil understanding. There are a few student-teacher interactions involving questions (Rosenshine & Stevens, 1986).

The COI techniques are characterized by instruction making mathematical content the focus of classroom activity and emphasis is on performance "drill theory" (Brownell, 1935). The techniques are characterized by full class as opposed to small group instruction. The teacher structures information and presents it to students, helps them to relate it to what they already know, monitors performance of students systematically, and provides systematic corrective feedback (Brophy & Good, 1986; Rosenshine & Stevens, 1986). Mathematics proficiency is achieved by shifting focus of the course from learning of mathematics per se to the learning of subject content. Research available indicates that COI functions and teaching behaviors that comprise them (e.g. teacher reviews of previous work) are among the teaching functions that have the highest correlations with student achievement (Anderson, Evertson & Brophy, 1982; Borich, 1988).

Supporters of the COI believe that the techniques are traditionally used to disseminate information, arouse student interest and can be indispensable (Kellough, 1994). It is the most effective instructional model for promoting achievement, mastery of content, and over-learning of fundamental facts, rules, and action sequence that might be essential to learning (Anderson & Block, 1987; Kellough, 1994). This strategy can improve students' receptive and recall skills but it is not successful in promoting an ability to engage in meaningful learning. Only students who possess a large number of cognitive structures associated with concrete operational period would be more apt to comprehend the content or concepts (Kellough, 1994). Different approaches that can be employed in the COI mathematics instruction (Cangelosi, 1992) include: lecture, discussion, demonstration, and expository techniques.

The lecture. The lecture commonly known as the talk and chalk approach is the strategy of direct instruction that is most frequently used and most abused (Kellough, 1994). The lecture approach, which is suitable for higher education, involves the teacher doing much of the talking while students listen to the teacher. The learner is generally passive and only has to memorize (Kellough, 1994). The effectiveness of the lecture strategy depends much on the speaking ability of the instructor such as vocal variety, audibility, gestures, and eye contact (Kellough, 1992).

Supporters of the lecture approach believe that it is a superior technique for demonstrating models and clarifying matters that may be confusing. It is inexpensive (Henson, 1993) but some people, such as Gagne (1985), who are opposed to the technique, assert that the lecture method is boring, the learner is not involved, and it does not recognize individual differences and produces more anxiety among students than any other method (Henson, 1993). The lecture method tends to be too fast, presents too much, teacher may not be heard and understood, and assumes students have heard and understood. It is characterized by the unidirectional mode of communication, no direct experience with the body of knowledge and has poor effect on retention (Kelloug, 1994). Gagne (1985) challenges the lecture approach as ineffective because it makes low cognitive demands on the learners.

The discussion. Discussion approach is a strategy that is both instructor - centered and student - centered. The teacher is responsible for structuring the flow of the interaction and for directing students' involvement and participation (Kellough, 1994). The approach requires a strong organization with a base of information, a central focus, effective questions, and a supportive classroom environment. The discussion strategy helps to create self-guided and independent students and can be responsive to students' needs. The students are actively involved in the learning, seek out information, respond and share their views and positions (Davis, 1993; Kellough, 1994). However, Davis (1993) cautioned that the approach can be unreliable and requires a lot of time to complete one presentation.

The demonstration. In the demonstration approach, the teacher models behaviors of presentation, analysis, and synthesis. The teacher is actively engaged in the learning activity while the students' role is that of observer, recorder, and evaluator of information or skills (Kellough, 1994). The approach can help to model skills, and illustrate points of the content through, for example, role play or demonstrating steps of Pythagorean theorem; and it becomes more effective when followed by a corresponding student activity (Kellough, 1994).

The Exposition. This is an approach in which the verbalization of a required concept is the initial step in the instructional sequence. The teacher presents the entire content of what is to be learned in its final form (Ausubel, 1961; Ornstein, 1995). The learner is only required to integrate this knowledge with the knowledge he/she already possesses. The approach is therefore more teacher-centered and the teacher is the major provider of information relating examples to abstraction being taught. Abstraction is stated by the teacher before examples are given and the examples are provided to help illustrate the abstraction (Ornstein, 1995). The technique is, however, suitable for recall but not for retaining mathematics concepts and transfer of heuristics of problem solving (Ausubel,

[illegible]

Classroom Organization

Educational research findings from cognitive psychology and mathematics education indicate that learning occurs as students actively assimilate new information and experiences and construct their own meanings (Case & Bereiter, 1984; Lampert, 1985,1986; Scohenfeld, 1987, 1992). This is a major shift from teaching and learning mathematics as accumulating facts to learning ideas. Effective teachers are those that can stimulate students to learn mathematics (i.e. away from merely memorizing toward mathematical reasoning; away from an emphasis on mechanistic answer finding toward conjecturing, invention and problem solving; away from treating mathematics as a body of isolated concepts and procedures toward connecting mathematics, its ideas and its applications) (National Council of Teachers of Mathematics, 1991; Resnick, 1983; Von Glassersfeld, 1987).

Mathematics teachers should monitor students' learning on an on-going basis in order to assess and adjust teaching (observe, listen, ask). Similarly, students' understandings and dispositions should guide teachers in shaping and reshaping the learning environment. Problem solving, reasoning and communication are processes that should pervade all mathematics instruction and should be modeled by the teacher. Mathematics instructors should not simply deliver content. Rather, they should facilitate learner construction of knowledge of mathematics (Bruner, 1986; Piaget, 1970). Mathematics pedagogy should focus on the ways in which teachers help students to come to understand and be able to do and use mathematics (Prawatt, Remillard, Putnam, & Heaton, 1992; Remillard, 1992).

Teachers need to employ a variety of alternative forms of instruction that permit students to build their repertoire of mathematical knowledge and their ability for posing, constructing, exploring, solving, and justifying mathematical problems and concepts (Ball, 1990). Teachers need to focus on creating a stimulating learning environment that encourages and motivates students to learn and like mathematics. Teachers need, therefore, to employ strategies that will facilitate effective students' participation in the learning activities. Along this idea, Tobin and Fraser (1988) reported that examplary teachers have high level of management efficiency, maintained class control, used strategies which ecnouraged students to participate in the learning activities and which incresed understanding. Tomic (1988), however, lamented that in most cases, teachers use blackboard, rarely gives examples of "real life application" of mathematical principles but questions make up 17% of interaction, high level wuestions which require more complex cognitive operations appear less frequently (3%).

There is evidence to support that teaching strategies used by teachers in their classroom practices may depend to some extent on their personal dispositions to those strategies. Those who believe in the appropriateness of a certain type of strategy would most likely be inclined to use. It is also possible that belief and practice may not be compatible.

Teachers' Beliefs About Teaching Strategies

For decades, educators have been interested in identifying what makes good teachers. One view purports demonstrated competency in subject matter knowledge. People who support this view would require no college training in professional education prior to entering teaching (Meyers, 1986). A second view is that subject matter knowledge is insufficient to make a good teacher. The emerging conventional wisdom is that it is important for teachers to know their subject matter but it is equally important for them to understand the pedagogical strategies attached to that knowledge (Elmore,1991).

The study of the nature of teachers' beliefs about the subject matter and about the teaching and learning of the subject matter are relatively new. Nonetheless, a number of studies in mathematics education (Thompson, 1984) have indicated that teachers' beliefs about mathematics and its teaching play a significant role in the teachers' characteristic pattern of instructional behavior (i. e. belief can shape their instruction and content coverage and has permeated all levels of curriculum) (Schmittau, 1991).

Any teacher who has been in class for some time knows that teaching is a fragile and sometimes puzzling process. Things can go well or a well planned lesson may flop when least expected (Thompson, 1984). The answer to this may be found in teachers' beliefs about teaching and of the subjects they teach. When teachers believe that students are able to learn mathematics and are responsible, they may view teaching and the teaching of mathematics, in particular, as their best job.

Teachers develop patterns of teaching behavior that are characteristic of their instructional beliefs. In some cases, these patterns may be manifestations of consciously held notions, beliefs and preferences that act as driving forces in shaping the teaching behavior (Thompson, 1984). There is strong reason to believe that in mathematics, teachers' conceptions about the subject matter and its teaching play an important role in affecting their effectiveness as the primary mediators between the subject and the learners (Thompson, 1984).

Ross, (1992) reported that teachers who believe they will make a difference are more likely to perceive, as an opportunity, a variety of teaching strategies so as to consolidate their teaching experience. In contrast, teachers who see student learning as swamped by uncontrollable forces might regard effective teaching strategies as more work, non profitable and not worthy. Teachers with strong belief in their effectiveness will likely be willing and motivated to regard using a variety of strategies as worthwhile.

It is a well known fact that teachers differ in their beliefs about students and also how the teachers feel and teach. The way in which teachers describe their view of instruction provides glimpses of the pedagogical knowledge that constitute "expertise or effectiveness" in teaching (Strahan, 1992). Different teachers, experts or novices, demonstrate different cognitive structures in regard to teaching and these differences affect their instructional planning, decision making and implementation (Clark & Peterson, 1986). Teachers with positive beliefs about student learning are likely to provide a variety of activities to meet diversities of students, individualize instructional strategies which accommodate different learning styles, organize classroom activities which encourage student participation and employ varieties of instructional methods (Pope & Scott, 1983).

Beliefs About Cognitively - Oriented Strategies

Teachers' beliefs about their capability to teach mathematics is fundamental. Thompson (1984) found that teachers' beliefs about mathematics and its teaching play a significant, albeit subtle, role in shaping their behavior. Thus one might expect that a teacher who holds that problem solving is important would tend to use an inquiry oriented approach to instruction. Such a style necessitates a certain decenteredness in which the role of the teacher yields to an emphasis on student generated ideas (Prawatt, et al, 1992).

The views teachers hold regarding how best they feel they can present the knowledge to students is fundamental. Some teachers may rely heavily on those techniques which merely present the content while others may employ those that will lead student to critical thinking and facilitate deeper understanding. Mathematics and science are two subjects that may require a wide variety of strategies but will depend on the teacher's belief about a particular strategy.

In a comparative study of elementary teachers, Kagan and Tippins (1990) found a difference in teachers' perception of teaching. Kagan and Tippins found that preservice teachers defined good teaching from a student perspective: in terms of fun, student involvement, positive reinforcement, and affective elements of a teacher's personality. Inservice teachers, on the other hand, defined good teaching from a teacher's perspective in terms of clear lesson structure with identifiable components (e.g. explicit objectives, definition of terms, examples, guided practice). Although the inservice teachers tended to be more critical of peer teaching and inductive strategies than preservice did, both groups were clearly more comfortable judging traditional, highly structured strategies of teaching than cognitively-oriented strategies (Kaggan & Tippins, 1990).

Teachers' beliefs about instructional techniques in mathematics is likely to affect how such a teacher might present knowledge to students. In as far as mathematics is concerned, teachers who believe in using and emphasizing cognitively-oriented strategies will tend to employ them in class, although beliefs and practice are two different things. The way in which knowledge is presented to students may eventually influence their attitudes toward mathematics and about the mathematics teacher.

Teacher Efficacy

Bandura's Self-Efficacy Theory

Asthon (1985) asserted that no other teacher characteristic is more powerful than teacher efficacy. The theoretical framework of sense of efficacy originates from Bandura's (1977) self-efficacy concept (Ashton & Webb, 1986). The theory states that belief in efficacy of one's effort is a mediating variable that determines the amounts of effort and persistence a person displays in performing particular tasks. In the theory, self-efficacy acts as a cognitive mediator of behavior. Self-efficacy refers to one's belief or judgment regarding one's capability to organize and implement actions necessary to attain designated performances which lead to anticipated outcomes (Bandura, 1977, 1986). This belief affects whether the individual will initiate a specific behavior and how long they will persist in their attempts to achieve that behavior. Bandura, however, cautions that efficacy belief alone will not determine the occurrence of a behavior. If the necessary skills and incentives are present, efficacy expectations play a major role in determining behavior.

Bandura's (1977) theory of social learning suggests that people develop a generalized expectancy concerning action-outcome contingencies based upon life experiences. For Bandura, behavior is enacted when not only people expect specific behavior to result in desirable outcomes (outcome expectancy), but also when they believe in their own ability to perform a behavior (self-efficacy). If Bandura's theory of self-efficacy is applied to the study of teachers, we might predict that "teachers who believe that student learning can be influenced by effective teaching (outcome expectancy beliefs) and who also have confidence in their own teaching abilities (self-efficacy beliefs) should persist longer, become more effective, and provide greater academic focus (Bandura, 1986).

Because teachers are expected to manage a wide range of social and academic processes in the school/class, it would follow that their beliefs concerning efficacy of their efforts may be important determinants of their persistence and the quality of their efforts. The theory suggests that there are two components of efficacy: outcome expectancy and efficacy expectations. Outcome expectancy is the belief that certain behaviors can lead to specific outcomes in generalized sense. Efficacy expectations, on the other hand, are an individual's beliefs about their own competence to bring about the outcome (e.g. if behavior was to lose weight, the desired outcome is to be thinner and efficacy expectation would be the belief that he or she can lose weight by restructuring caloric intake or increase exercise).

A strong sense of efficacy enhances human accomplishment and personal well - being in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided (Bandura, 1977, 1994). Such an efficacious outlook fosters intrinsic interest and deep engrossment in their activities. They set themselves challenging goals and maintain strong commitment to them, they heighten and sustain their efforts in the face of failure, and quickly they recover their sense of efficacy after failures or set backs. They attribute failure to insufficient effort or deficient knowledge and skills that are acquirable.

In contrast, people who doubt their capabilities shy away from difficult tasks. They have low aspirations and weak commitment to the goals they are to pursue or achieve. They slacken their efforts and give up quickly in the face of difficulties. They fall easy victim to stress and depression (Ashton & Webb, 1986; Bandura, 1977, 1994).

The concept of self-efficacy combines notions of locus of control (attribution) with notions of perceived competence (self worth) (Thomas, Englert & Gregg, 1987). Locus of control is defined as the belief or perceived source of control (internal or external) over one's behavior. Perceived self efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events (Bandura, 1994). Such beliefs determine how people feel, think, motivate themselves, and behave. Such beliefs produce these diverse effects through four processes: cognitive, motivational, affective, and selective processes. Self efficacy is central to motivation (Ashton & Webb, 1986) and has the potential to link ideas on intrinsic motivation, highlight the importance of an individuals' personal control and power to shape events.

Sources of self efficacy. People's beliefs about their efficacy undergoes changes throughout the life span (Bandura, 1994). Personal attributes of teachers as well as their perceptions of the school or instruction are instrumental in creating in teachers a sense of personal teaching efficacy (i.e. a feeling that they can motivate even the most difficult students (Ashton & Webb, 1986; Bandura, 1984, 1994). Efficacy is believed to be affected by many factors like one's success levels, exploratory experiences of an individual, familial organization, peer influences, goal-setting, and formative presence of expectations (Ashton & Webb, 1986, Bandura, 1994). Major sources of efficacy include:

1. Mastery experiences, that is successes build robust belief in one's efficacy and failures undermine it. A resilient sense of efficacy requires experience in overcoming obstacles through perseverant effort.
2. Vicarious experiences provided by social models, that is seeing people similar to oneself succeed by sustained effort raises one's belief that they, too, possess the capability to succeed.
3. Social persuasion i. e. verbally people can be told that they possess the capabilities

required to succeed.

4. Somatic and emotional states pattern, that is people interpret their stress reactions and tensions as signs of vulnerability to poor performance or physical debility. Consequently, sense of efficacy can influence a teacher's effectiveness in their teaching responsibilities (Good & Tom, 1985).

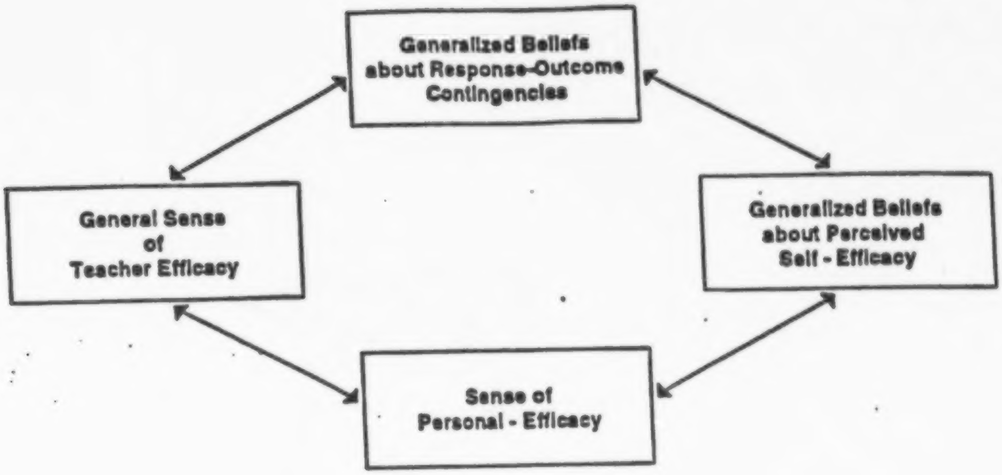
Conceptualizing Teacher Efficacy

Teacher efficacy is conceptualized as the beliefs teachers have about their skills and abilities to achieve desirable learning outcome by students (Ashton & Webb, 1986). It refers to teachers' situation-specific expectation that they can help students learn. That expectation rests on assumptions of how much students are capable of learning what schools have to teach (Ashton & Webb, 1986). Teacher efficacy expectations influence their thoughts and feelings, their choices of activities, the amount of effort they expend, and the extent of their persistence in the face of obstacles (Bandura, 1986).

Teacher efficacy has been conceptualized as having hierarchically organized relationships. A model of teachers' sense of efficacy (Ashton & Webb, 1986) posits several relationships among teachers' beliefs (see Figure 2). At the top of the model are generalized beliefs about the extent to which a teacher believes that actions can produce a desired outcome that lead to general teacher efficacy and to general sense of effectiveness as a person. The integration of the general sense of efficacy plus general beliefs about one's efficacy lead to the formation of personal teaching efficacy beliefs which are specific beliefs about one's personal ability to influence pupils (Ashton & Webb, 1986).

Figure 2

Teachers' Sense of Efficacy (Ashton & Webb, 1986, p.5)


Generalized Beliefs about Response-Outcome Contingencies
General Sense of Teacher Efficacy
Generalized Beliefs about Perceived Self - Efficacy
Sense of Personal - Efficacy

Teacher efficacy is defined as the teacher's belief in her or his ability to affect students' performances (Armor, Conroy, Cox, King, McDonald, Pascal, Pauly, Zellman, Summer, & Thompson, 1976; Ashton & Webb, 1986). It is conceptualized as the extent to which teachers believe that they have the capacity to affect students' performance. Teachers' sense of efficacy consists of two independent dimensions: general teaching efficacy (GTE) and personal teaching efficacy (PTE) (Ashton, Olenjik, Crocker & McAuliffe, 1982; Ashton & Webb,1986; Gibson & Dembo, 1984; Woolfolk & Hoy, 1990).

General teaching efficacy (outcome expectancy) is the more generalized belief about the relationship between teaching and learning (i.e. teachers' belief regarding the extent to which they can motivate students to achieve). It is the general belief that a teacher's ability to bring about change in student learning is significantly limited by factors external to the teacher (such as home environment, family background, IQ of the child). Hence, students can be taught given such factors as IQ, family background, academic ability, school condition, and favorable environment (Ashton et al., 1976; Gibson & Demdo, 1984).

Personal sense of efficacy, on the other hand, is the teachers' belief about their own effectiveness in teaching in that a teacher believes he or she has the skills and abilities to bring about student learning (i.e. the feeling that with his or her effort, he or she can have an impact on learning, influence learning, and bring about positive student change and motivation- personal responsibility in student learning) (Armor et al, 1976; Ashton,1984; Ashton, Webb, & Doda, 1983; Berman, McLaughlin, Bars, Pauly, & Zellman, 1977; Gibson & Dembo, 1984).

Antecedents of Teacher Efficacy

Although teacher efficacy seems to be an important mediator variable in human behavior, research indicates that it may be influenced by other factors, too. Ashton (1985) notes that "...student ability appears to be the single most significant characteristic affecting a teacher's sense of efficacy". Studies (e. g. Parkay, Olejnik & Prollen, 1986) have examined the effects of school climate variables on teacher efficacy. For example, proportion of low-achieving students in a teacher's classroom had a negative direct effect on personal efficacy; interaction with colleagues carried a positive indirect effect; school-level measures of academic emphasis, school integrity and Principal's influence correlated with either personal or general teaching efficacy. Efficacy of teachers is also substantially influenced by historical achievement performance of students in mathematics (Moore, 1994).

Teacher training and teacher efficacy. Research on teacher efficacy and teacher training has documented that a number of different teacher's behaviors are associated with efficacy beliefs (Ashton & Webb, 1986; Gibson & Dembo,1984; Gorrell & Capron, 1989). Benz, Alderman, Bradley, and Flowers (1992), Cooper and Robinson (1991) and Lent, Lopez and Bieschke (1991) have suggested that teachers who feel less effective may not have been trained and lack motivational strategies. Spector (1990) found that personal efficacy among undergraduates increased linearly during a 4-year undergraduate program that culminated in student teaching but general efficacy declined after student teaching. Consistent with this finding, Hoy & Woolfolk (1990) reported that personal efficacy was higher among practicing teachers who had taken extra graduate courses in education. Ashton (1984) suggested that teacher education programs might utilize the concept of teacher efficacy belief to assist preservice teachers in clarifying their beliefs and " . . . develop a well organized conception of their efficacy beliefs..." (p.29).

Comparing elementary and secondary school teachers, elementary teachers showed greater efficacy than secondary teachers (Gibson & Dembo, 1984) but Post, Stewart, and Smith (1991) did not find any difference between secondary and elementary school teachers' efficacy. In other previous research, differences in efficacy between elementary and secondary teachers were revealed (Alderman & Benz, 1985). Secondary student teachers had lower pre-student teaching efficacy than elementary student teachers but made larger gains in post student teaching efficacy.

This finding lends support to the earlier work of Gibson and Dembo (1984). Both personal and general efficacy were found to be higher among elementary teachers than among high school teachers (Parkay, Olejnik & Prollen, 1986). It is not, however, clear whether the difference was attributed to school effect or merely reflects differences among people who select elementary or secondary teaching. In a study by Guyton, Fox and Sisk (1991) on teachers under Alternative Preparation program and traditional teacher education, they found no difference between them for either construct of teacher efficacy.

Teaching experience and teacher efficacy. There is evidence that teachers' sense of efficacy varies with teaching experience. Brown (1987) found preservice teachers to have high sense of teaching outcome expectancy (general efficacy) but a low sense of personal teaching efficacy. The more experienced teachers clearly demonstrated higher efficacy than the less experienced. A comparison of first-year, fifth year and former teachers' sense of efficacy revealed a stronger sense of efficacy among first and fifth year teachers than among former teachers (Glickman & Tamashiro cited in Trentham et al, 1985). Hoy and Woolfolk (1993) found that experience significantly related to personal efficacy ($r = .17$, $p < .01$)

The experienced teachers seem to have large agenda, take contextual variation into account, and immediate decisions. They are generally domain-specific, are organized for interpretative efficiency, use powerful analytical tool, and adapt entire semantic or proportional mapping to events (Leinhardt, 1986). Novices have a greater tendency to focus on internal dimensions of problems presented or to emphasize surface characteristics of classroom events. A second essential cognitive characteristic of expert is the tendency to use higher order systems of categorizing the problems encountered.

In another study, Broussard, Book and Byars (1988) compared entry and exit teacher education students with experienced teachers and found that teacher education students were more optimistic and that the sense of efficacy grew weaker as experience increased. In comparison with experienced teachers, the student teachers rated themselves more effective than experienced teachers. Another report by Dembo and Gibson (1985) and also Gibson and Demdo (1982) found that entering teachers have substantially stronger personal efficacy than do long-term teachers but as time passes (sometime after the tenth year of experience), teacher efficacy begins to decline (Bruner, 1990) due to failure and frustration in life.

Experienced teachers would be expected to portray higher efficacy than novice teachers because:

1. They possess superior conceptual subject matter and knowledge about students, about teaching, and about the context or situation in which the learning and teaching take place.

2. They possess streamlined and automated procedures for managing the classroom. These skills have become so automated that conscious cognitive resources can be directed to other aspects of teaching and learning.

3. They command strategic knowledge/instructional strategies to facilitate learning (e.g. communicating objectives, giving directions, presenting content clearly, adapting instruction to students' ability levels and interests, connecting new material to existing concepts, giving specific informative feedback and giving more attention to student performance relative to instructional goals.

Gender and teacher efficacy. Largely, as a result of socialization experiences, women exhibit lower expectation than men for many achievement-related behaviors, thus failing to fully realize their capabilities and talents in career pursuits. Evans and Tribble (1986) found that female preservice teachers had significantly greater personal teaching and general teaching efficacy than males had.

There is evidence to suggest that gender differences exist with regard to teachers' sense of efficacy (Greenwood, Olejnik, & Parkay, 1990). Women tend to manifest lower sense of efficacy than men. There are generally few women in science and technological fields due to lower efficacy in mathematics relative to men (Goldman & Hewitt, 1976). These gender differences in mathematics avoidance have been thought to result from socialized negative attitudes and affective reactions to mathematics (Hendel, 1980).

Relationships Among Teacher Efficacy, Teachers' Beliefs, Teaching Practices, and Student Outcomes in Mathematics

Teachers' Beliefs, Practices and Classroom Organization and Teacher Efficacy

Teacher efficacy has been identified as an important variable in accounting for and differentiating the more effective from less effective teachers, especially in terms of students' achievement (Berman & Mclaughlin, 1977; Greenwood, Olenjik & Parkay, 1990). For example, teachers with a low sense of efficacy doubt their ability to influence student learning; consequently, they tend to avoid activities they believe to be beyond their capabilities. In contrast, teachers with a strong sense of efficacy believe that they are capable of having a positive effect on student performance, develop challenging classroom activities and help students on their tasks. They are apt to persist longer with students having trouble to learn (Ashton, & Webb, 1986).

Teacher efficacy offers a powerful construct for understanding teachers' definitions of their roles, their attitudes toward their work, and their interactions with students. As such teacher efficacy is a useful guide for designing and evaluating staff development (Mackenzie, 1987). Studies have found that teacher efficacy predicts teachers' implementation of innovative programs and student achievement. McLaughlin and Marsh (1978), using the Rand (single questionnaire item for each of the two dimensions), found evidence of causal chain from teacher efficacy to teacher behavior to student efficacy to student behavior and to student achievement. Ashton and Webb (1986), also using Rand, found that Rand 1 (general teaching efficacy) influenced language performances. In addition, Anderson, Green and Loewen (1988) used an instrument developed by Gibson & Dembo and found that personal teaching efficacy predicted student achievement in language, reading and mathematics in grades 3 but not in 6.

Teachers' perceptions of their own teaching competence influences their choices of classroom management and instructional strategies. Teachers who doubt their ability and sense of effectiveness experience debilitating stress and are unable to perform as well as they might in the classroom because they are distracted by worry (Ashton & Webb, 1984). Research on the efficacy of practicing (field or experienced) teachers has also reported strong significant relationship between teachers' sense of efficacy and increases in students' scores on achievement tests (Ashton, Webb & Doda, 1983). Doyle's (1986) study found that novice teachers who lacked efficacy found managing classroom disciplines and motivating students problematic.

A positive self-efficacy may lead the teacher to set positive reflections of teaching behaviors (e.g. hard work, understanding of concepts taught, perseverance, determination to achieve, and interest in the work). Armor et al (1976) reached a similar conclusion in the evaluation of the school Preferred Reading Program in Los Angeles. Teacher efficacy leads to a greater willingness to try new methods (Ashton & Webb, 1986), which may result in higher achievement in students which in turn, increases teachers' sense of efficacy and willingness to continue to expend greater efforts to help students' learning. These researchers reported that the greater the teacher's sense of efficacy, the more their students advanced in achievement.

In one study, significant correlation was found between efficacy scores and commitment to teaching among preservice (student-teachers) teachers (Evans & Tribble, 1986; Kalian & Freeman, 1987). Kalian and his colleagues reported that teacher candidates (preservice) with high levels of self confidence were more willing to hold teachers accountable for students' learning

Teachers with high levels of personal teaching efficacy were more likely to expect that all students can learn and such teachers would feel responsible for that learning than were teachers with low efficacy (Ashton & Webb, 1986). Similarly, Stein and Wang (1988) found a relationship between teacher improvement in the implementation of new teaching approaches and self efficacy with those of high efficacy reflecting better performance than those with low efficacy. Coladarci (1991) also found that both general and personal efficacy emerged as strong predictors of commitment to teaching (r = .31) and (r = .25) respectively. Greater teaching commitment tended to be expressed by those teachers who were higher in both general and personal efficacy hich predicted commitment to teaching.

There also exists evidence that teachers' beliefs in their abilities to instruct students may account for individual differences in their effectiveness (Armor et al, 1976; Berman and McLaughlin, 1977; Brookover, Beady, Flood, Schweitzer & Wissenbaker, 1979; Brophy & Evertson, 1977). Berman & McLaughlin (1977), in their evaluation of " Projects of the 1965 Elementary and Secondary Education Act" in the USA found that the most important characteristic determining the effectiveness of change in teachers was the teacher's sense of efficacy - a belief that teachers can help even the most difficult or unmotivated students.

Teacher efficacy is related to several teacher behaviors and beliefs, such as the use of time, class management, questioning, and referral decisions (Gibson & Dembo, 1984; Podell & Soodak, 1993; Woolfolk & Hoy, 1990, Woolfolk, Rogoff, & Hoy, 1990). Woolfolk and Hoy (1990) concluded that teacher efficacy is one of the few teacher characteristics that consistently relate to teaching and learning. Podell and Soodak (1993) added that teachers' beliefs seem to influence their decisions regarding instruction. Personal efficacy, rather than general efficacy seems to matter in the decisions teachers make about students. Hall, Hines, Bacon, and Konlianos (1992) reported that teachers characterizedwith personal teacher efficacy beliefs were more apt to emphasize the role of the teacher, view the teacher as being directly or indirectly responsible for teacher-students' progress in learning.

The extent to which teachers believe they have the capacity to affect student performance is a very powerful teacher attribute related to learning outcomes (McLaughlin & Marsh, 1978). A teacher's belief that he/she can teach, regardless of student performance, is the most powerful factor (Meyer, 1985). If teachers strongly believe that they can teach and that students can learn, they are less likely to engage in negative instructional practices and behaviors. Along these same lines, Ashton et al., (1983) were able to show that teachers with high sense of personal efficacy are more positive communicators with their students. They are also better classroom managers, less defensive, more accepting to student disagreement and challenges, and produce greater student achievement as a result. Evidence gathered from classroom observation indicates that high and low efficacy teachers behaviorally differ in what ways they affect student outcomes (Ashton et al, 1983); Gibson & Dembo, 1984).

Student Outcomes in Mathematics and Teacher Efficacy

Research reveals that teacher efficacy is a meaningful contributor to student academic achievement (Armor et al. 1876; Ashton & Webb, 1986; Berman and McLaughlin et al., 1977). Students of highly efficacious teachers display higher levels of academic achievement than do students of low efficacy teachers. Berman and McLaughlin (1977) also reported that the "single most powerful explanatory variable" (p. 73) related to student performance and teacher change was teachers' sense of efficacy. Ashton (1984) asserts “no other teacher characteristic has demonstrated such a consistent relationship to student achievement” (p. 28).

Unfortunately, the literature on teacher attribution indicates that many teachers attribute the lack of student success to non school factors; thus, they establish a mind set against examining their own responsibility for student success (Guskey, 1987). Armor et al. (1976), Ashton and Webb (1982) , Brookover et al. (1979), Brophy and Evertson (1977) and Gibson and Dembo (1984) have noted that there is a strong link between teacher’s sense of efficacy, teachers’ classroom behaviors and students’ achievement.

In another study, Ashton et al (1983) investigated the relationship between efficacy and pupil achievement in a basic mathematics communications class. Pupils in the class were low achievers. It was found that GTE, but not PTE were significantly related to achievement in mathematics while PTE was significantly related to language achievement. It was suggested that teacher efficacy seemed to vary for different situations. Similarly, Ashton and Webb (1986) discovered that teacher efficacy was positively related to student achievement in mathematics, language, and communication among high school students enrolled in basic skills classes. Tracz and Gibson (1986) reported that GTE correlated with language and mathematics achievement which supports the contention that teacher's sense of efficacy is significant in student achievement.

One would, therefore, predict that teachers who believe that students' learning can be influenced by effective teaching, and who also have confidence in their own teaching abilities should persist longer, provide greater focus in the classroom, exhibit different types of feedback, and employ effective teaching strategies that facilitate active student participation and critical thinking beyond the content (i.e. applicability & synthesis) than those with low efficacy.

Teachers' expectations of students' abilities affect the type of feedback they give to students and the cognitive and motivational demands they place on students. These factors, in turn, influence students' performance (Brophy & Good, 1970; Cronin, 1986; Rosenthal & Jacobsen, 1968). Evidence exists to support that teachers' beliefs in their ability to affect student learning and achievement are related to teachers' consequent effectiveness to teach (Brookover, Beady, Flood, Schweitzer & Wisen, 1979; Brophy & Everston, 1976). However, in contrast, Hillman reported that the sense of teacher efficacy had a small effect on student achievement (B = .005). Schaller and Dewine (1993) also reported that teacher efficacy did not make a meaningful contribution to effective student learning.

Summary of Literature

Teachers play an important and complex role in mathematics instruction. They have a significant impact on how much students learn, and on what they learn. Some teachers are consistently more effective teachers than others. This variation depends a lot on teacher personal and situational (latent) variables such as the sense of efficacy, teaching experience, and attitudes.

Teacher efficacy is teacher's belief that they can influence student learning. The higher the efficacy the more likely that a teacher will exert much effort in teaching practices. Teacher efficacy consists of at least two dimensions that correspond to Bandura's two component model of self efficacy, general and personal teaching efficacy.

Teachers possess conceptions about teaching and also about their students and the social role of their class. These conceptions appear to play a significant role in affecting instructional behavior. Teachers' classroom behavior is believed to be some kind of manifestation of the teacher's belief about the subject matter and how it should be taught. Therefore, teachers' beliefs about instructional strategies in mathematics could be a manifestation of what they constantly do in mathematics class.

Attitude toward mathematics and achievement in mathematics have been found to correlate with teacher efficacy and also between themselves. Attitude also correlates with student achievement. Positive attitude will yield positive performance and vice-versa. Generally, the literature indicates that efficacy is related to performance and that certain background and current situational factors may affect efficacy.

CHAPTER 3 - THEORETICAL FRAMEWORK AND RESEARCH QUESTIONS

Theoretical Framework

The review of the literature in the preceding chapter has highlighted the nature of instruction in general, and instructional strategies in mathematics, in particular. The literature has illustrated the complexity of the teaching and learning process. Research has shown that there are numerous intervening variables between teaching and students' learning in general and in mathematics in particular. These findings supported Porter and Brophy's (1988) model of teaching, which emphasizes the sheer complexity of the teaching task and of the milieu in which it is conducted (see Figure 2).

The literature has shown that teaching, the main task of the teacher, depends on many factors such as differences in efficacy which in turn affects both attitudes and achievement of children. Teacher efficacy has been documented as one of the variables that have significant impact on teachers' behavior and student attitudes and achievement.

Social learning theory provides the lens through which teachers' beliefs are measured and examined. Beliefs have been closely linked to behavior through self-efficacy (Bandura, 1977) from which the concept of teacher efficacy is derived. Teacher efficacy is a cognition that is manifested in teacher behavior. A teacher's sense of efficacy influences the behaviors that he or she displays in the classroom (Bandura, 1986; Denham & Michael, 1981). Highly efficacious teachers expect positive student learning outcomes to result from their teaching. These teachers will act on this expectation by exhibiting behaviors intended to positively impact student learning. Conversely, teachers with a low sense of efficacy may fail to display efficacious behaviors in the classroom.

The purpose of the present study was to develop and test a model of teacher efficacy and its antecedents and consequences in Uganda. The proposed model (see Figure 3) is derived from existing literature (Brown, 1987; Gibson & Dembo, 1984; Relich, Debus & Walker, 1986) and attempts to extend the implications to self-efficacy theory as presented by Bandura, 1986. Using this model, the study sought to examine the influence of teacher efficacy on teachers' teaching practices, classroom behavior, and student outcomes. Teachers' gender, years of teaching experience, level of teacher training as well as the location of schools, urban or rural, and achievement level of the school were treated as exogenous variables that could influence teacher efficacy and teachers' beliefs of the use of instructional strategies.

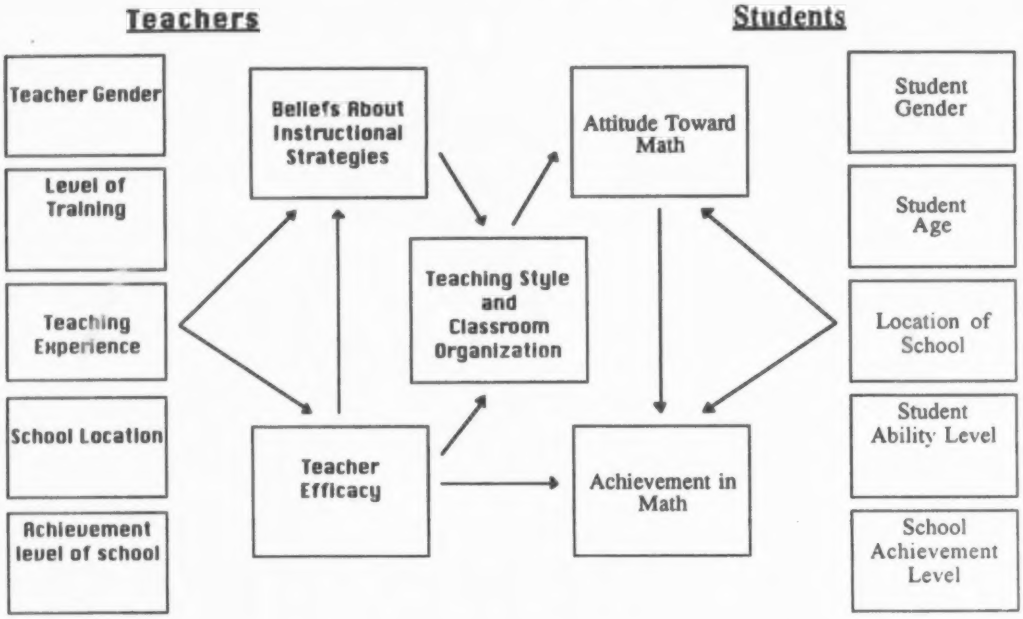
Teacher efficacy, as an endogenous variable, was expected to have a direct influence on teachers' beliefs about instructional strategies, and actual teaching strategies they employ, and their classroom organization. Actual teaching strategies used and the nature of classroom organization were hypothesized to directly influence students' attitudes toward mathematics and their achievement in mathematics. It was also hypothesized that teacher efficacy would exert direct influence on students' attitudes toward mathematics and student achievement in mathematics.

The model also specifies that there are direct effects of students' age, gender, student ability level, location of school, and achievement level of school on students' attitudes toward mathematics and their achievement in mathematics. Students' attitudes are also hypothesized to influence their achievement in mathematics, although it is possible that the influence between attitude and achievement is reciprocal (Aiken, 1970).

Teacher efficacy, students' attitudes towards mathematics, and achievement in mathematics were the three major constructs of this study.

Figure 3

Path Model of Relationship Between Teacher Efficacy, Teacher's Behavior, and Student Outcomes


Teachers
Students
Teacher Gender
Level of Training
Teaching Experience
School Location
Achievement level of school
Beliefs About Instructional Strategies
Teacher Efficacy
Teaching Style and Classroom Organization
Attitude Toward Math
Achievement in Math
Student Gender
Student Age
Location of School
Student Ability Level
School Achievement Level

In this study, emphasis was not only on teachers' beliefs about their general ability to influence students but also on their beliefs about their ability to implement specific teaching strategies in mathematics. Teachers with the belief regarding the use of specific strategies should use the strategies more often than those teachers whose beliefs are different.

Following Gibson and Dembo's (1984) recommendations, the study was designed to investigate (a) the relationships between teacher characteristics (e. g. sex, teaching experience, grade levels, and personal attributes) and sense of efficacy, (b) relationships between situational and organizational variables such as SES and location of schools, (c) relationship between teacher efficacy (and each of its components) and student achievement, and (d) relationships between teacher efficacy and observable classroom process variables such as student engagement, teaching techniques and classroom organization and management.

Several features were built into the study to guard against the following: First, the researcher administered the questionnaires with supplied alternatives from which to choose in order to elicit the subjects' theoretical beliefs and feelings about familiar aspects of their behaviours. Second, they were asked to respond to open-ended questions (interviews) in which they supplied their own feelings, described and explained general issues regarding mathematics instruction. Self-report data tend to be largely accurate when people are asked about familiar matters that they have thought about and experienced and when they are allowed to respond in their own words (Ericcson & Simon, 1980; Shavelson & Stern, 1981). Finally, a sample of teachers were observed in their classrooms actually teaching mathematics to their students. This observation was to help assess the validity of their self reports (Brophy & McCaslin, 1992) and be able to derive other necessary and relevant information.

Research Questions and Hypotheses

The literature points out that many teacher, student, and learning environment variables can significantly affect the manner in which knowledge is disseminated to students. Teachers' sense of efficacy, that is "their belief in their ability to have positive effect on student learning" (Ashton, 1985, p. 142), is one of the few teacher characteristics consistently related to student achievement. Many environmental factors such as school climate, availability of resource materials, learning ability and motivation of students, are likely to affect teachers' sense of efficacy (Ashton, 1985).

This study was guided by several questions and hypotheses which are grouped into six categories. Hypotheses were developed where the dependent variables were directly predictable from independent variables.

Antecedents of Teacher Efficacy - Research Hypotheses

H 1.1: Male teachers in elementary schools will be higher in their sense of personal and general efficacy than female teachers.

H 1.2: The teachers' sense of efficacy will be higher in teachers with more years of teacher training than those with less teacher training.

H 1.3: Teachers with more years of teaching experience will be higher in their sense of personal and general efficacy than those teachers with less experience.

H 1.4: Teachers' sense of efficacy will be higher in urban teachers than rural teachers.

H 1.5: The sense of personal and general efficacy will be higher for teachers in schools with high achievement than those in teachers in schools with low achievement.

Relationship Between Teachers' Efficacy and their Beliefs about Teaching strategies and Classroom Organization: Research Questions

RQ 2.1: Does teacher efficacy relate to teachers' beliefs about instructional strategies in mathematics ?

RQ 2.2: Does teachers' sense of efficacy differentiate teaching styles and classroom organization?

Relationship Between Teacher Efficacy and Student Outcomes: Research Questions

RQ 3.1: Does teacher efficacy affect students' attitudes towards mathematics?

RQ 3.2: Does teacher efficacy affect students' achievement in mathematics?

Antecedents of Students' Attitudes Toward Mathematics: Research Hypotheses

H 4.1: Girls will be less positive than boys toward mathematics.

H 4.2: Older pupils will show more positive attitudes and less anxiety toward mathematics than younger students.

H 4.3: Pupils of higher ability will be more positive towards mathematics than those of medium and lower ability.

H 4.4: Urban pupils will be more positive and less anxious about studying mathematics than rural pupils.

H 4.5: Pupils from schools with high achievement level will be more positive and less anxious about studying mathematics than those from schools with lower or medium achievement.

Antecedents of Achievement in Mathematics - Research Hypotheses

H 5.1: Boys' performance in mathematics will higher than girls'.

H 5.2: Older children will achieve higher in mathematics than younger children.

H 5.3: Pupils of higher ability will achieve higher in mathematics than those of medium and lower ability.

H 5.4: Urban pupils will achieve higher in mathematics than rural pupils.

H 5.5: Pupils from schools with high achievement will achieve higher in mathematics than rural schools with lower or medium achievement.

Relationship Between Students' Attitudes Toward Mathematics and Achievement in Mathematics - Research Hypothesis.

H 6.1: Students' attitudes toward mathematics will correlate positively with achievement in mathematics.

Definition of Terms

Terms central to this study were defined as follows:

Elementary (Primary) schools: These are schools in Uganda constituting the first level of the Education cycle. They are comprised of grades (classes) 1 to 7

Teacher Efficacy: Teacher's belief about her/his ability to cope in different situations as measured by the teacher efficacy scale.

General efficacy: extent to which a teacher believes that he or she can teach pupils under a given set of conditions.

Personal efficacy: teacher's belief in his or her own ability to affect learning of any student and their achievement.

Strategy: the systematic plan, style or management of teaching.

Belief about instructional strategies: The feeling or view one has toward the types of instructional methods that can be used for teaching mathematics i.e. content or cognitive methods.

Teaching strategies: careful systematic plan or distinctive manner which the teacher chooses to use to deliver content. It is used interchangeably with style. Content strategies are those approaches that put emphasis on the presentation of knowledge; cognitive strategies are those that emphasize participation and thinking by learners.

Teaching or instruction: used interchangeably to refer to the process of imparting knowledge/ or delivering content.

Teaching experience: The number of years spent teaching in the schools especially since graduation from Teachers' College.

Attitudes : acquired predispositions to react constantly, mental set held by students about mathematics which makes them to constantly think, feel or are disposed to react to it positively or negatively (i. e. the amount of affect for or against mathematics).

Achievement: the measure of how much a student has scored on a mathematics examination given at the end of academic term. The examinations were teacher-constructed and standardized for a group of schools.

CHAPTER 4 - METHOD

This chapter will present the setting of the research with emphasis on sampling procedures. The subjects who participated in the study will be described: first, the teacher sample, and second, the student sample. Next, the instruments of the study will be described beginning with the instruments for teachers and then for students. Finally, procedures used, limitations, delimitations of the study, analysis of data, and ethical considerations will be discussed.

As stated in the preceding chapters, the purpose of the study was to develop and test a model of teacher efficacy in order to (a) examine the influence of teachers' sense of efficacy on teachers' beliefs about instructional strategies in mathematics, and to (b) explore possible relationships between teacher efficacy, students' attitudes toward mathematics, and their achievement in mathematics. The methods employed included a quantitative survey and qualitative description using questionnaires, interviews, and observations. This study attempted to integrate the three because (a) the questionnaire is more focused than the interview, (b) the interview is quite exploratory as opposed to questionnaires, and (c) the observation can provide an insight into actual behavior that is sought.

Sampling Procedures

It is critical that samples of children and teachers be representative of the target population. In this study, the target population for field teachers were the mathematics teachers in primary schools and students in Teachers' Colleges. For pupils, the target population was the pupils in the primary schools. This exploratory and descriptive study was conducted in four randomly selected districts in Uganda. From three to four districts that comprised each of the four administrative regions, northern, eastern, mid-western and central, one district was selected at random (see Appendix E). In each district there were about 40 schools and one teachers' college. Four schools were sampled from each district. The schools were chosen on the basis of their achievement levels as measured and determined from primary leaving examinations (P.L.E.) results over the years. Due to circumstances beyond the researcher's jurisdiction, it was not possible to adequately and proportionally sample schools, teachers, and students.

To choose the schools, I consulted the local education officers for advice about the achievement level of the schools. The schools were stratified as those with high, medium, or low achievement. The schools with high achievement were those considered to have high academic excellence while those with low achievement were thought to be consistently having poor results. On the basis of the advice from the officers, I chose schools that represented each level of achievement. Altogether, 16 schools were selected: 5 of high, 5 of medium, and 6 of low achievement levels.

The schools selected included nine urban schools and seven rural schools. Most urban schools serve predominantly students from moderate to high socio-economic status. The pupils who attend these schools are tribally and religiously diverse with a wide range of abilities. Most urban schools are those of high achievement. In contrast, rural schools serve predominantly low SES students, and many of the schools are of low to moderate achievement.

In the selected schools, field teachers of mathematics from primary 3 to 7 were invited to participate in the study. In some schools, the same teacher taught mathematics in more than one class. So, to obtain a fairly large sample size, invitation had to be extended to many teachers. Seventy eight questionnaires were given out and 75 teachers from primary 3 to 7 returned their questionnaires.

The preservice teachers in Teachers' Colleges who were invited to participate in the study were those in their final year. There was a college in each of the districts selected for the study. In each college, there were about 40 to 50 students in the final year and 20 students were randomly selected for the study. Only 62 returned their questionnaires. Out of those who returned the questionnaires, 56 had their questionnaires with all parts complete.

The pupils from primary 5 to 7 were invited to participate in the study. Primary 5-7 pupils were selected because these grades have been shown to be critical in the development of mathematics attitudes (Callahan, 1961). Callahan found that as many as 50% of students at these grade levels experience a change in their attitudes toward mathematics. In addition, in Uganda, primary 7 is the year when students write the first national examinations that determine their potential of proceeding to the next ladder in the education system. Primary 5 and 6 classes are equally important because they constitute the preparatory stages for writing the primary 7 examinations.

Based on performance differences, the pupils in each class were, first, stratified by their teachers as (a) high achievers, (b) medium achievers, and (c) low achievers. The students who did not perform well in academic tasks were categorized as low or under achievers and those who performed well were categorized as high achievers. Low achievers were those students who may possess the ability to achieve considerably higher grades than their present records showed. In fact, some of those categorized as low achievers in mathematics were high achievers in other subjects. From each stratum, about 2/3 of the pupils were randomly sampled to participate in the study. Over 1500 students particicpated in the study with only 1475 returning their questionnaires.

Data were also obtained from field teachers and pupils through interviews. Both the teachers and pupils were randomly sampled, from among those who had responded to the questionnaires, to eliminate bias of selection. In all, 18 teachers and over 80 pupils participated in the interviews. A sample of 23 teachers was also selected for lesson observation.

Teachers and students in the elementary schools were selected for this study because the elementary school years constitute basic education. In addition, the government of Uganda's concern about teacher training and quality as well as their concern about the performance in mathematics and other science subjects inspired the study. The schools and colleges, though located in different regions or districts, follow a centralized curriculum and syllabi which were developed by the National Curriculum and Development Center (NCDC) and the Institute of Teacher Education, respectively. The students that join the colleges are believed to have similar academic ability, after completion of secondary education.

Subjects

Teacher Sample

Of the sample of 136 teachers, 131 (75 field and 56 pre service) returned their questionnaires. The majority of the teachers in this sample were male, 62% (n = 81); 38% (n = 50) were female and of the 75 field teachers, 15 were female (20%). There were 26 field teachers from rural schools and 49 from urban schools. The field teachers were those teaching from primary 3 to 7, while the preservice teachers were those still in college undergoing training to become teachers.

Sixty four of the field teachers (85%) had already attained the minimum required grade 3 Teacher's certificate and nine of them (20%) had enrolled for the Diploma courses at the National Teachers' Colleges (N.T.C's) which entitles them to teach in post-primary institutions and new salary scale. About 10% of the teachers had already attained Diploma in Education (DIP/ED.). Six of the field teachers were untrained (licensed) and one teacher (a foreigner) had a University degree. These teachers were trained at different colleges in the country butwhich follow a centralized syllabus. The range of teaching experience of the participating field teachers varied from 1-year to 25 years with mean of 5.3 years.

The pre-service teachers (student teachers) were still in the Teachers' Colleges undergoing training. The preservice teachers who participated in the study were those in their final year, had at least gone through the first school practice (practicum), and therefore, had experienced actual classroom teaching. Since they were randomly selected, they could be assumed to be representative of students in Teachers' colleges. Their ages ranged from 20-35 years.

Student Sample

More than 1500 pupils from Primary 5 to 7 were invited to participate in the study with 1475 returning their questionnaires, though some of them did not fully complete the questionnaire. Of these 1475 pupils, there were 802 girls (54%) and 668 boys (46%). The other remaining 5 pupils did not indicate their gender. The pupils ranged in age from 9 to 17 years, the average being 12.3 years. Some pupils (n = 200) did not indicate their ages and could not be included in the computation for age differences. Across classes, 459 of the pupils (31%) were chosen from Primary 5, 542 (37%) from Primary 6, and 473 (32%) from Primary 7.

The pupils were categorized as low- achievers, medium- achievers, and high-achievers. Of these pupils, 32% (n = 465) were low achievers, 38% (n = 566) were medium achievers, and 30% (n = 443) were high achievers. In terms of the schools, 23% of the pupils (n = 340) were chosen from schools with low achievement, 22% (n = 329) from schools with average achievement, and 55% (n = 805) from schools with high achievement. The achievement levels of the schools were determined on the advice of the local education authorities on the basis of Primary Leaving Examinations results of these schools over the years.

Instruments

The composite multi-item instruments for teachers consisted of two different measures: Teacher Efficacy Scale and Teacher Belief Scale. The two scales for teachers and one for pupils (Mathematics Attitude Inventory) were administered. As well, mathematics tests which were nationally designed under the education officers' supervision and management, were used in this study. A personal data sheet was attached to gather background and demographic information about the teachers and pupils in the study (see Appendix A1). This demographic information included facts about gender, age, school and its location, teaching experience, class, and the level of training.

Instruments for Teachers

Teacher Efficacy Scale. The more recent Teacher Efficacy Scale (TES), which measures the variables of general and personal teaching efficacy, uses a version of Gibson and Dembo's (1984) teacher efficacy scale. The scale consists of 30 items that were on a five point-Likert scale ranging from strongly agree (SA) to strongly disagree (SDA) (see Appendix A2). The scale measures two dimensions, personal teacher efficacy (PTE) and general teacher efficacy (GTE) (Gibson & Dembo, 1984; Hoy and Woolfolk, 1990).

The TES by Gibson & Dembo yielded internal consistency reliability coefficients of .78 for personal teaching efficacy and .75 for general teaching efficacy. Gibson and Dembo performed multitrait multi-method analysis that supported both convergent and discriminant validity of the scale (reported in Woolfolk & Hoy, 1990). In the present study, personal and general efficacy were formed by computing unweighted sums of 15 items for each scale. For each of the two dimensions, general teaching efficacy and personal teaching efficacy, the higher the score the more efficacious were the teachers' efficacy beliefs.

Internal consistency of the 30 items for the total scale and the 15 items for each of the two dimensions was checked using responses of the 131 teachers in the current study. The Cronbach's alpha coefficient of reliability was found to be .67 for the total scale, .68 for personal efficacy, and .34 for general efficacy.

Teacher Belief Scale. The Teacher Belief Scale (TBS) contained 32 items from Collier's (1972) Beliefs about Mathematics Instruction Scale (BMIS). The BMIS, which originally had 40 items, yielded original consistency reliability coefficient of .83. Items on the TBS were on a 5 point-Likert scale ranging from strongly agree to strongly disagree (see Appendix A3). Seventeen items measured teachers' beliefs about the appropriateness and effectiveness of cognitively-oriented strategies, and 15 items measured their beliefs about the appropriateness of content-oriented strategies. Internal consistency of the 32 items for the scale was checked using the responses of the 131 teachers in the study. The reliability coefficient for the scale in this study was .72 and for each of the two subscales of content and cognitive strategy were .67 and .64 respectively.

Interview. Data collection also included interviews. The interview was an open (unstructured) one. A subsample of several mathematics teachers was interviewed about the kinds of behaviors of children in class that were thought to enhance or impede mathematics teaching and learning, achievement, and attitude. The interview was designed to gather information about: (a) their salient beliefs about the outcomes of learning mathematics in school; and (b) the kinds of behaviors in class that, in teachers' opinions, would enhance or impede their learning and achievement in mathematics. The interview gave the teachers an opportunity to "describe their own life-world, their opinions and feelings in their own words".

The validity of the interview interpretation was taken care of by ensuring factual accuracy of respondents' own account through correct recording and description.

Observation checklist. Data on teachers' behavior, practice and process variables were obtained by direct, systematic observation of lessons. Observation of lessons taught was conducted in order to become acquainted with the social setting of the class and to be able to generate conjectures about the teaching of mathematics. For their own reasons, many teachers were not willing to have their lessons observed. However, 23 teachers volunteered and were observed teaching mathematics. Each teacher was observed twice in the first few weeks of the third term (late August-September). The researcher personally observed the teachers' lessons using a checklist (observation coding system or guide) developed by the researcher (see Appendix C).

A second observer was incorporated to provide a check on the observer's reliability of coding. The observation focused on teacher-student behaviors, teaching behaviors, notice board displays, text and exercise books of children, seating arrangements, questioning techniques, feedback sequences, lesson content, and lesson presentation styles. Using the observation coding system, the teachers were rated as very good (4), good (3), average (2), fair (1) and unsatisfactory (0). The mean scores for each teacher were then separately computed for instruction time, classroom environment, classroom organization, and instructional strategies. A high mean score in instruction time meant a lot of time spent teaching content; for classroom organization and environment, it meant positive clssroom atmosphere; and for instructional strategies, it meant more use of cognitively-oriented strategies.

Correlation between the observer pair was calculated to assess reliability of the observations. T-test values were computed for each item to fidn differences between the observer and th researcher's rating differences in each item. Except for four items, differences in rating did not emerge between the observer and researcher. Inter-rater reliability for overall observations was assessed and no significant difference between the pair of observers existed ($r = .59$, $p < .01$).

Instruments for Students

Mathematics Attitude Inventory. The mathematics inventory scale (MAI) (see Appendix B) was developed by the Minnesota Research Evaluation team of the Department of Educational Psychology and was administered to pupils in primary 5 to 7. The MAI was selected because it investigates the multidimensional nature of the characteristics of pupils' attitudes toward mathematics. The scale consists of 48 items, with responses made on a four-point Likert scale of strongly agree, agree, disagree and strongly disagree. The scale measures students' attitudes toward mathematics in terms of six underlying constructs (factors): (a) perception of mathematics teacher, (b) anxiety toward mathematics, (c) value of mathematics in society, (d) self-concept in mathematics, (e) enjoyment of mathematics, and (f) motivation of mathematics.

1. The Perception of the Mathematics Teacher subscale reflects a student's view regarding the teaching characteristics of her or his mathematics teacher. A high score indicates a favourable view of the mathematics teacher.

2. The Anxiety toward Mathematics subscale reflects the uneasiness a student feels in situations involving mathematics. A high score indicates high anxiety toward mathematics.

3. The Value of Mathematics in Society subscale reflects a student's view regarding the usefulness of mathematical knowledge in our society. A high score indicates high perceived value of mathematics.

4. The Self-Concept in Mathematics subscale reflects a student's self perception of her/his own competence in mathematics. A high score indicates a favourable self-concept in mathematics.

5. The Enjoyment of Mathematics subscale reflects the pleasure a student derives from engaging in mathematical activities. A high score indicates high enjoyment of mathematics.

6. The Motivation in Mathematics subscale reflects a student's desire to study and do mathematics beyond the class assignments. A high score indicates high motivation in mathematics.

Each subscale had 8 items and each reported a maximum score of 32 and minimum score of 8 with the high scores representing a more positive attitude. The possible maximum score for the whole scale was 192 points and the minimum was 48 points. The alpha reliability of the total MAI scale was .81. The alpha reliability coefficients of the subscales were .83, .86, .78, .84, .89, and .76 respectively (Sandman, 1976, 1980).

Internal consistency of the 48 items for the inventory and 8 items for each of the six subscales was checked by using responses of the 1475 students in the current study . The Cronbach alpha coefficient of reliability for the MAI was found to be .71. For each of the six Scales, the reliability coefficients were found to be as follows: perception about the teacher .68, anxiety .33, value of mathematics .65, enjoyment of mathematics .59, self concept of their ability in mathematics .66, and motivation to learn mathematics .51.

Mathematics achievement tests. Tests of achievement must be relevant to the children's experiences. Children were expected to be exposed to concepts and skills as outined in the school syllabus. Achievement in mathematics was measured in two phases: at the end of April (first term) and end of August (second term). A mean score was derived from the two term scores to improve the reliability of the tests. The scores from the two terms were correlated and was found to be high (r = .72).

The achievement tests were criterion reference tests constructed by teachers to measure achievement of subject matter taught during the academic year. The tests were constructed, administered, scored and graded under the jurisdiction of district/municipal education officers. The tests consisted of a number of cognitive level categories not necessarily arranged in any order of cognitive complexity. The categories consisted of (a) comprehension of concepts (e.g. additions, etc), (b) computation, (c) application and problem solving, (d) operation, (e) number sets, and (f) others like fractions and graphs.

These locally designed mathematics achievement tests were used as the measures of achievement in mathematics performance because the teachers' assessments and attitudes toward students were most likely to be influenced by the students' grades or marks rather than by standardized tests scores.

Procedures

Permission to conduct the study in Uganda was obtained from the relevant authorities. First, clearance was obtained from the Uganda National Council for Science and Technology and the President's Office to allow me carry out research in Uganda. Second, the Ministry of Education had to grant permission to conduct the study in schools in Uganda. Third, the local District Executive Secretaries and District or Municipal Education Officers were approached for permission to conduct the research in schools under their jurisdiction. Finally, the Heads of Institutions were asked for permission to carry out the study in their respective schools or colleges. With all these permissions duly granted, the study began. In each of the schools, the following procedures were undertaken:

Teachers of mathematics from primary 3 to 7, preservice teachers in colleges, and students from primary 5 to 7 were asked if they were willing to participate in the study. The aim of the study was explained to them and they were assured of anonymity and confidentiality of any information that they would provide in the study. The teachers who were willing to participate responded to the Teacher Efficacy and Teacher Belief Scales while the pupils responded to the MAI and wrote achievement tests. Simple random sampling could not be performed to select the field teachers because most classes were taught mathematics by a single teacher. Pre-field teachers were selected by simple random sampling and they also responded to the two scales.

The questionnaires were administered to the field teachers by me and to preservice teachers, except in one college, by the Principals of the respective colleges. The reason why I did not administer the questionnaire at the other colleges was that the students were out of the colleges for their second phase of the practicum and were not easily accessible. I hoped that the responses expressed by those students represented their own feelings. Teachers' and students' understanding of items in the scales could not be clarified, and the few omissions in the items indicates some difficulty in responding to these items. An interview would clarify some of the responses and allow teachers to elaborate their ideas.

Students in primary 5-7 were selected by simple random sampling from their achievement groups (i.e high achievers, average achievers, and low achievers). The Mathematics Attitude Inventory was administered to the students and they indicated whether they strongly agreed, agreed, disagreed or strongly disagreed with each statement. They were given 20-30 minutes to complete the questionnaire in order to allow those students who were slow in reading and writing to be able to complete the questionnaire. Unfortunately, a small number of students, about 30, were not able to complete the questionnaire and they were not included in the future part of study.

The questionnaires were administered by the researcher in order to ensure similar instructions to the respondents and to create similar conditions during the exercise. In all classes, the questionnaires were administered in the presence of and with the cooperation of subject or class teachers. These regular classroom teachers helped with explanations of some unfamiliar terms to students, especially those students with reading difficulties.

The students were told that there were no right or wrong answers and that every response they gave was important provided they were real reflections of their own feelings. They were reminded to think only of their present mathematics class when answering the statements and to consider each statement carefully. They were encouraged to seek or ask for clarification of meaning of certain terms in the questionnaire such as "at ease, upset, fun", and others.

Additional information was also obtained through interviews with field teachers and pupils. The interview was designed to elicit information about the factors that might influence children's learning and performance in mathematics with an emphasis on attitudes and achievement. Because it was difficult to interview over 70 teachers and over 1000 pupils individually, this part of the study was conducted with a subsample constituted by selecting 2 to 3 teachers in each school and 5 to 8 boys and girls at random from each class (5-7). This sampling procedure resulted in the selection of 18 teachers and 80 pupils.

Interviews were conducted throughout the study. They were conducted after the questionnaires had been administered, and before lesson observationstook place. Teachers were interviewed individually but students were in some cases interviewed in groups of 2-5 . This was due to little time granted by the school adminstrators and the time available to the researcher. The group interview with the students could have influenced the nature of the responses.

The researcher carried out classroom observations of a subsample of teachers' lessons randomly selected to examine the relationship between teacher efficacy and teaching strategy and classroom organization. Each participating teacher was observed twice. Duration of lessons tended to range from 40 to 80 minutes. Narrative records, based on the researcher's guidelines, were taken during the lessons to provide a descriptive survey. Foci of observations were on teacher-student interaction, classroom management strategies, and the use of instructional strategies.

Brief training of the 2 observers was conducted. This training consisted essentially of discussion to familiarize the observers with the coding instrument. Interobserver agreement between the observers and the researcher was first estimated using pairwise observed scores, then reliability of the observations by determining consistency coefficient alpha was computed and found to be .59.

Limitations

Schools were selected on the basis of accessibility and convenience (e.g security, transport, finance) and on the basis of apparent achievement level (i.e. schools with high, average, and low achievement). The schools and the students who participated are a very small proportion of all the primary schools and pupils (limited size of subject sample) and therefore findings from the instruments (questionnaires) might be somewhat situational and generalizations will have to be made with caution. The study lasted five months and was only confined in the middle of school year, which was the second term (May- September, 1994) of the academic year. It was not possible to study the normal all year round teaching and learning situation in mathematics and other subjects.

Direct communication with school administrators and persons involved in the development and monitoring of mathematics programs such as those officials in the Inspectorate division of the Ministry of Education, NCDC, and Uganda National Examinations board (UNEB) was not possible because of limited time the researcher had. Another weakness of the study was lack of controls. A control comparison with other subjects and/or secondary schools could have been conducted. It is possible that subjects may not have provided genuine responses and there was no way that this could have been controlled. Finally, elementary pupils have limited reading abilities, and that could have affected their understanding of the items in the questionnaire.

In this study, teachers were expected to describe their beliefs about the usefulness of content and cognitive based instructional strategies in teaching mathematics. This type of method yields self-report data that are open to memory failure and distortion, social desirability responding, and all other threats to reliability and validity that are involved in asking people to report on their own behaviour, especially through hypothetical retrospective reporting (Ericcson & Simon, 1980; Nisbett & Wilson, 1977).

Delimitations

This study investigated teacher efficacy and perception of instructional strategies of elementary teachers and attitudes toward mathematics and achievement in mathematics of students in Uganda. The following delimitations were considered: The study focused only in mathematics teachers' sense of efficacy and students' attitudes toward and achievement in mathematics. The study did not attempt to measure changes in the sense of teacher efficacy and students' attitudes towards mathematics over a period of time. This study focused on mathematics only and generalization of the findings will be confined to mathematics only and cannot be extended toto other subjects and activities.

The study was confined to four of the 33 districts which is a small proportion of districts in the country. It was also confined to a few samples in elementary schools. Participants were only those teachers who were, at the time of the study, teaching mathematics in classes 3 to 7 in the selected schools and volunteered to participate. The study was restricted to government schools only for the purpose of ensuring that there was uniformity in the syllabi used. The schools were from different Foundation bodies (e.g Catholic, Protestant, Islam, and Indian).

Analysis of Data

Several statistical analyses relevant to the study questions were selected to analyze the data:

1. The mean scores and standard deviations were obtained for teacher efficacy, students' attitudes for each of the six scales of attitude toward mathematics and for achievement in mathematics. If a subject failed to respond to an item in any of the questionnaires, it was not figured into the average score. The means were computed to compare the scores across different groups in the study. The standard deviations were computed to assess the magnitude in variations of the scores.
2. The t-test analysis was carried out to find out whether there were significant differences in criterion variables with two groups and the assumptions of the t-test were met.
3. Analysis of variance (ANOVA) and Multivariate analysis of variance (MANOVA) were performed to test for the mean differences in exploring the research questions. ANOVA was conducted to test whether there were significant differences between the groups on a single dependent variable. MANOVA, on the other hand, was performed to study the

differences among the groups in terms of many dependent (criterion) variables considered simultaneously.

4. Pearson correlation coefficient analyses were performed to determine the relationships between the variables and which of the independent variables correlated with criterion variables at the $p < .001$, .01, or .05 level of significance.

5. Stepwise multiple regression was applied in a linear predictive model to determine the effects of teacher efficacy on teachers' beliefs about the use of strategies, and students' attitude towards mathematics and achievement in mathematics as well as the effect of students' attitudes towards mathematics on mathematics performance.

Ethical Considerations

The importance of abiding by bureaucratic and human respect was honoured and every effort was made to fulfill these expectations. All aspects of the study procedures followed the guidelines set out by the department of Educational Psychology, University of Alberta. The Ethics expectations of the Department of Educational Psychology, University of Alberta were met and the study received approval from the Deparment's Ethics Committee according to the University of Alberta Policy related to Ethics in Human research (see Appendices 1-2).

In Uganda, too, the research guidelines by the Uganda National Council for Science and Technology were followed. Permission was obtained in writing from the relevant national and local authorities such as the Ministry of Education and local district authorities such as DEO's and Admiministrative Secretaries (see Appendices 3-13). Consent from respective headteachers of schools and Principals of colleges was obtained verbally before the study began. Permission from parents was not obtained because it was assumed that the head teachers' permission represented the parents, especially due to the fact that some students were in boarding schools and could not access their parents.

Some of the guidelines followed with the participating teachers and pupils included obtaining informal verbal consent of the participants, informing the participants what the study was about and assuring them of their right to withdraw from the study if they so wished for their own reasons. They were assured of confidentiality and anonymity of information that they would provide and the results that would be obtained from such information. Numbers were assigned to participants for identification, and to ensure that their identities would not be revealed to other people who might come across the information.

CHAPTER 5 - RESULTS

This chapter presents the results from a study that examined a model of teacher efficacy beliefs and the relationship of those beliefs to teachers' beliefs about instructional strategies in mathematics, teachers' teaching behaviors, students' attitudes toward mathematics, and students' achievement in mathematics in elementary schools in Uganda.

The purpose of this study was to investigate and test certain portions of the teacher efficacy model developed for the study. In particular, the study investigated (a) the antecedents of teacher efficacy , (b) the relationship between teacher efficacy and teaching strategies and classroom organization, (c) the relationship between teacher efficacy and student oucomes, (d) the antecedents of students' attitudes toward mathematics, (e) the antecedents of achievement in mathematics, and (f) the relationship between students' attitudes toward mathematics and their achievement in mathematics.

Raw scores for the study were obtained from the Teacher Efficacy Scale, the Teachers' Belief Scale, the Mathematics Attitude Inventory, teacher-designed tests, interviews with teachers and pupils, and observations of teachers actually teaching lessons. Descriptive and inferential techniques were used to analyze the data, test the research hypotheses, and answer the research questions.

This study was designed to test several hypotheses and answer several research questions regarding teacher- student learning characteristics with regard to teacher efficacy, teaching strategies, students' attitudes toward mathematics, and their achievement in mathematics. For the sake of clarity and consistency, the results will be presented question by question following as much as possible, the order in which the questions or hypotheses were stated in chapter 3. Although the study was initially designed to examine many variables, only those facets, as stated in the research questions, have been highlighted for the purpose of this thesis.

Antecedents of Teacher Efficacy

Data about the antecedents of teacher efficacy were obtained from a personal demographic background questionnaire. Data about teacher efficacy came from the Teacher Efficacy Scale. The antecedents of teacher efficacy investigated were gender, educational attainment, teaching experience, location of school, and school achievement level.

Teacher's Gender

The means and standard deviations for efficacy scores of the male and female teachers are presented in Table 2. Table 2 shows that both the scores for male and female teachers were higher in personal efficacy than they were in general efficacy. Hotellings T^2 for significant difference between male and female teachers was computed for personal and general efficacy scores. There was no statistically significant difference in teachers' sense of efficacy between male and female teachers, $T^2 = (2,127) = .35$, $p > .05$. No significant difference emerged also in their personal efficacy, $t\ (128) = .01$, $p > .05$), and general efficacy, $t\ (128)\ .70$, $p > .05$). The t-test for total efficacy yielded no significant difference, $t\ (128) = .59$, $p > .05$).

Table 2

Teacher Efficacy as a Function of Teachers' Gender, Educational Attainment, and Amount of Experience

		Teacher efficacy					
		General		Personal		Total	
Antecedents	n	M	SD	M	SD	M	SD
Gender							
Male	84	49.9	5.86	56.1	6.23	106.0	9.54
Female	46	48.9	7.07	56.0	5.72	104.9	11.48
Educ. attainment							
Diploma	8	48.1	4.36	57.1	8.4	105.3	11.96
Grade 3	60	49.0	6.97	57.0	6.40	105.9	10.17
Preservice	54	49.5	5.66	54.6	6.83	104.1	10.04
Untrained	8	55.1	4.64	58.4	4.84	113.5	7.89
Years of experience							
10+	18	56.2	6.86	56.2	6.86	102.8	11.84
6-8	16	57.9	6.74	57.9	6.74	105.1	9.84
4-5	12	55.8	8.29	55.8	8.29	104.8	11.90
2-3	21	57.2	5.56	57.2	5.56	106.10	9.65
1	7	58.7	4.71	58.7	4.57	111.6	6.16
Preservice	56	49.8	5.74	54.9	6.83	104.6	.91

Educational Attainment of Teacher

Table 2 presents means and standard deviations of efficacy scores for teachers with different levels of educational attainment. Data in the Table show that for all teachers of the different levels of educational attainment, their raw scores in their sense of personal efficacy was higher than their sense of general efficacy. Multivariate analysis of variance did not yield statistically significant difference between teachers with different levels of training in personal and general efficacy, F (6, 248) = 2.00, $p > .05$. There was no significant difference, too, in personal efficacy, F (3, 126) = 1.60, $p > .05$, and general efficacy, F (3,126) = 2.47,

$p > . 05$. ANOVA for total efficacy did not yield a significant difference, F (3,126) = 2.03, $p > .05$).

Amount of Teaching Experience

Mean scores and standard deviations in efficacy for teachers with different years of teaching experience are also shown in Table 2. The data reveal that the teachers' sense of personal efficacy did not systematically change with teaching experience, while there was a tendency for general efficacy to change. Multivariate analysis of variance (MANOVA) was performed to determine the difference between all the variables together.

MANOVA did not yield statistically significant difference between personal and general efficacy across all the groups, F(8,134) = .39, $p > .05$. There was also no significant difference in personal efficacy, F (4,69) = .37, $p > .05$ and general efficacy, F (4, 69) = .52, $p > .05$ between teachers with different years of teaching experience. Similarly, Analysis of variance (ANOVA) did not yield statistically significant difference in total efficacy, F (4, 69) = .59, $p > .05$.

When preservice teachers were compared with field teachers, the Hotellings T^2)results indicated no statistically significant difference in teachers' sense of efficacy, (2,127), 2.01, $p > .05$ as well as the teachers' sense of personal efficacy, F (1,128) = 3.32, $p > .05$ and general efficacy, F (1, 128) = .14, $p > .05$. The t-test showed no significant difference between field and preservice teachers' in their total efficacy scores, t (128) = .91, $p > .05$).

Location of School

Means and standard deviations of teacher efficacy scores for teachers in rural and urban schools are presented in Table 3. Hotellings T^2 for the analysis of difference in the mean scores between rural and urban teachers showed no statistically significant difference, T^2 (2,71) = 1.38, $p > .05$. The t-test for each dimension also showed no statistical difference between the rural and urban teachers in their sense of personal efficacy t (72) = 1.64, $p > .05$) as well as general efficacy t (72) = .59, $p > .05$) and total efficacy t (72) = .30, $p > .05$).

Table 3

Teacher Efficacy as a Function of School Location and School Achievement Level

		Teacher efficacy					
		General		Personal		Total	
Antecedents	n	M	SD	M	SD	M	SD
School Location							
Rural	17	48.2	5.37	58.8	7.60	107.0	9.49
Urban	57	49.7	7.10	56.5	6.06	106.2	10.54
School Achievement Level							
High	27	48.6	8.40	57.1	6.46	105.4	11.60
Medium	31	48.4	4.82	56.5	6.49	104.9	9.11
Low	17	52.6	6.14	57.8	6.56	110.4	9.83

Achievement Level of Teacher's School

In Table 3 means and standard deviations in the efficacy scores of teachers who taught in schools with low, average, and high achievement are shown. A multivariate analysis of variance (MANOVA) was performed, but significant differences did not emerge in teachers' efficacy across the schools, F (4,138) = 1.21, $p > .05$ nor in personal efficacy, F (2,71) = .20, $p > .05$ and general efficacy, F (2,71) = 2.44, $p > .05$. ANOVA showed no significant difference in total efficacy scores, F (2,71) = 1.64, $p > .05$).

Summary

Data about antecedents of teacher efficacy showed that there were no statistically significant differences in teachers' rating of their personal, general and total efficacy feelings with regard to their gender, level of training, teaching experience, location of school, and school achievement level.

Relationships Between Teacher Efficacy, and Teachers' Beliefs about Teaching Strategies, and Classroom Organization

Teacher Efficacy as a Predictor of Teacher's Beliefs About Instructional Strategies

Table 4 summarizes the correlation coefficients among the efficacy and belief variables. General efficacy significantly and moderately correlated with belief about content strategy ($r = .35$, $p < .01$) but had low correlation with belief about cognitively-oriented strategies ($r = .22$, $p < .05$). Personal efficacy, on the other hand, had low, but correlation with both belief about content-oriented strategies ($r = .27$, $p < .01$) and cognitviely-oriented strategies ($r = .29$, $p < .01$). These correlations indicate that general efficacy was a stronger predictor (12.4%) of teachers' beliefs about content-oriented strategies than personal efficacy, which was a stronger significant predictor of teachers' beliefs about cognitively-oriented strategies in mathematics (8.5%) than general efficacy.

Table 4: Correlation Matrix for Teacher Efficacy and Teachers' Beliefs about Instructional Strategies in Mathematics

	Content-strat.	Cognitive-strat.	General effic.	Personal effic.
Content-strat.		.35 * * *	.35 * *	.27 * *
Cognitive-strat.			.22 *	.29 * *
General effic.				.24 *
Personal effic.				

* * * p < .001, * * p < .01, * p < .05

To determine whether personal efficacy and general efficacy independently influence teachers' beliefs about instructional strategies, I performed 2 stepwise linear multiple regression analyses, one using content-oriented strategies as the criterion variable, and another using cognitively-oriented strategies. The predictors were entered on the basis of magnitude of correlation with the criterion variables. Results re presented in Table 5.

Table 5

Multiple Regression Results Using Teacher Efficacy to Predict Teacher's Beliefs About Instructional Strategies (N = 130)

Significant Predictor	R	R^2	F	Beta	T
Content-oriented strategies					
General efficacy	.35	.12	12.41* * *	.30	3.55 ***
Personal efficacy	.40	.16	11.80 * **	.20	2.36 *
Cognitively-oriented strategies					
Personal efficacy	.29	.09	11.94* * *	.29	3.46***
General efficacy	.22	.05	6.48 * *	.22	2.65*

* * * $p < .001$, * * $p < .01$, * $p < .05$

Results in Table 5 indicate that both personal efficacy and general efficacy have significant influence on teachers' beliefs about content-oriented abd cognitively-oriented instructional strategies in mathematics. Personal efficacy significantly accounted for the variance in teacher's beliefs about content-oriented strategies by 16%, F(1, 138) = 11.80, $p < .001$, while general efficacy by 12%, F (1, 130) = 12.41, $p < .001$. Similarly, personal efficacy accounted for te variance in the relationship with teacher's beliefs about cognitively-oriented strategies by 9%, F (1, 130) = 11.94, $p < .001$, while general efficacy did so by 5%, F (1, 130) = 6.48, $p < .05$.

Teacher Efficacy and Teaching Strategy and Classroom Organization

The purpose of the observation was to verify if low and high efficacy teachers employed different teaching styles and classroom organization. A series of ratings were made with 5-point scales. The information gathered during the observations included data on the use of teaching techniques and instructional time (total time, time spent on various classroom activities such as seatwork, review, development, conclusion, task).

The teachers were categorized as high efficacy or low efficacy teachers on the basis of the scores obtained from responses in the TES. During the observation, it was not yet known who of the teachers would be classified as low or high efficacy. Hoy and Woolfolk (1990) commented that identifying high or low efficacy teachers is not a simple task because of the two dimensions of teacher efficacy. In this study teachers were categorized by identifying cut off scores for low efficacy at 40 or less and for high efficacy at 55 and above.

Among the 23 teachers whose lessons were observed, 14 were classified as low efficacy and 9 were classified as high efficacy. Evidence gathered from classroom observation indicates that high and low efficacy teachers behaviorally differed in their teaching styles and classroom organization (see Table 6).

Table 6

Teacher Efficacy as a Factor in Teaching Behavior and Classroom Organization of High and Low Efficacy Teachers

	High efficacy		Low efficacy	
	M	SD	M	SD
Instruction time	2.4	.47	1.4	.74
Class environment	2.5	1.06	2.4	.76
Classroom organization	3.4	.09	1.7	.13
Instructional strategies	3.1	.76	1.4	.11

4 = Very good, 3 = good, 2 = average, 1 = fair, 0 = unsatisfactory

Teachers of high efficacy appeared to have clear specification of their lesson objectives and they used varied lesson formats to suit the topic and the needs of students. They were seen to be engaged in more problem solving behaviors, presented information more clearly, asked higher cognitive level questions, though not very often, and appeared more enthusiastic and task oriented than low efficacy teachers. Even students in their classes appeared to be more attentive and responded readily to teachers' questions.

The high efficacy teachers endeavored to utilize varieties of cognitively-oriented instructional strategies such as (a) discussion in which students became active contributors of answers, (c) discovery in which students were guided into solutions, and (c) cooperative or group work. A couple of high efficacy teachers endeavored to relate math concepts and content to students' real life experiences by providing meaningful and relevant examples.

The high efficacy teachers were perceived by the observers to have greater confidence and enthusiasm, have less anxiety and were more receptive to student input, had more productive time and seemed more concerned with academic achievement of their students. In most cases, the questions they asked were high-order questions that required some thinking on the part of students, used fewer vague terms, gave less seat work, and gave academic encouragement, for example, praise and rewards.

Classroom management of high efficacy teachers was characterized by efficient learning environment such as quality and pacing of instruction was interesting with enough coverage of content and the information presented made sense to the pupils. Knowledge was presented in an organized, orderly way and the lessons were related to the level of the students. They tried to improvise, used audio visual teaching aids, like metre rulers, tins, boxes, and blackboard illustrations. They also paid attention to slow learners as well as to girls.

High efficacy teachers appeared more effective in leading students in discussions. These teachers appeared to be effective classroom managers, consistent in rule enforcement, monitored their class behaviors systematically, accepted less disturbance, had fewer interrruptions and had more efficient transitions from one step to another such as linking theme from one step to the other.These high efficacy teachers used the conceptual presentation of content that conveyed a view of mathematics as a set of integrated and interrelated topics and referred to the heuristic processes of mathematics.

The low efficacy teachers, on the other hand, tended to dominate the talking characterized by teacher's explanations of facts and demonstration of skills. They were only interested in demonstrating the procedures that students were to use in performing the tasks to be assigned. The examples they cited were not directly relevant to the class, for example examples in the text book which are from another context. They tended to teach little, for a short time but gave a lot of seatwork.

The low efficacy teachers presented the subject matter as a finished product and used a computational approach that portrayed mathematics as a collection of more or less arbitrary rules and procedures for finding answers to specific questions. For example, in teaching the volume of a block, they provided the formula as l x h x w = 6 x 5 x 3 = 90m^3. To construct 30 degrees, change the radius of the compass. To find the circumference of a circle use 2IIr or IId. No attempts were made to involve students into thinking or active participation in the lesson such as finding the relationship between circumference and diameter.

The low efficacy teachers presented lessons in an orderly and logical sequence, avoiding digressions to discuss related issues and students' ideas. In most cases, back benchers and slow learners who appeared to be reflective were not paid attention to, while fast learners remained redundant. Time spent on revision of previous lesson or assignment (25-30%) seemed to be more than for teaching new content; time spent introducing new concepts ranged between 10-20%; time spent on seatwork (written or oral) was about 20-50%; and time spent on unrelated interrruption was about 5-10%.

Unlike high efficacy teachers who used praise such as “well tried, good attempt, and keep trying” for incorrect responses pupils providedto the teacher’s questions, low efficacy teachers used criticisms. They appeared less effective in class management. The few questions that most low efficacy teachers asked were predominantly of the low-order type (convergent questions) that were mainly centered around factual information and lacked cognition (thinking), for example, what is the area of a football field with l = 100m, and w = 50 m?.

Some other common elements that characterized lessons of low efficacy teachers included wrong presentation of facts that students absorbed and memorized (e.g. 1 metre = 100000 mm; 1 kg = 500 gm; L= 2, W = 8), confusing or unclear presentation of facts which were not meaningful to pupils (e.g. divide 2000 by 1000 mm) without illustrations. They did not relate the subject matter to life experiences of the pupils or to substantiate the reasons for doing so. They appeared uninterested in the teaching, and the examples they cited tended to be on the same thing throughout the lesson and not directly meaningful to students' life experiences. There was an apparent inadequate preparation of content leading to little presentation of content.

There were instances of obviously very poor English grammar which would not convey the message effectively to the pupils. e.g. " car travels at a distance of 120 km, a car travelling in 80 km in 2 hours, how many times do you take to Lira?". These kinds of grammatical errors were repeated throughout the lesson. In addition, there were a couple of lessons with incorrect spellings and cases of unclear concepts that were not well explained and were abstract to pupils (e . g. sets, operations, graphs, geometry). Many teachers had the tendency to use big words (unfamiliar terminology) and did not bother to explain them to pupils. An element of unnecessary time wastage at the beginning of the lessons on almost trivial matters with very little relevance to students' was dominant with low efficacy teachers. This delay led to very little being taught and in the long run, much of the syllabus was not covered.

Whole class teaching based on individualistic setting where classes were structured for students to work individually with limited interaction in achieving learning goals was the main practise in most classes. Teachers asked questions and waited for children to raise their hands and then called on volunteers (called students by names especially in rural classes). Boys tended to put up hands and were called on more often than were girls. They were even given more feedback and praise for their success than were girls. Low achievers became increasingly passive and disengaged. Teachers called on them less often and even gave them less reaction time to respond. Where they failed, as they often did, the teachers either gave them the answers rather than guidance or ignored them and rarely gave praise for their succes or effort. Girls and the slow learners learned not to volunteer to answer or to question, even if they knew the answers, in order to avoid negative feedback.

Teacherss lesson plans employed similar lesson steps based on introduction, experiencing phase, sharing phase, and evaluation phase.

Summary

High efficacy teachers appeared more effective and tended to employ cognitively-oriented teaching strategies more than low efficacy teachers did and their classroom organization was more favorable. Whole class teaching was, however, a common manifestation in several lessons with a focus on teacher-centered and examination-oriented rote memory approach.

Relationship Between Teacher Efficacy and Student Outcomes

Teacher Efficacy and Students' Attitudes

First, correlation coefficients between efficacy dimensions and scores in attitudinal variables were computed. To obtain these coefficients and regression values, teachers were matchedmatched with their students. Single mean score for students' attitudes toward mathematics was then derived for each teacher, and the scores were correlated with teacher efficacy scores.

Scores in total efficacy scores produced a weak, positive but significant correlation with scores in total student attitude ($r = .11, p < .05$). Personal efficacy ($n = 40$) showed a weak and positive correlation with students' attitudes ($r = .21, p > .05$) but general efficacy ($n = 40$) was uncorrelated with students' attitudes ($r = -.03, p > .05$). Efficacy recorded an insignificant, negative correlation with anxiety ($r = -.16, p > .05$) and no correlation with enjoyment and self perception in mathematics. Personal efficacy scores correlated negatively with anxiety and positively with the rest but general efficacy showed no correlation with all the attitudinal variables.

I performed 2 enter multiple regression analyses utilising attitude towards mathematics as the dependent measures and teacher efficacy dimension as the predictor variables. The results (see Table 7) indicate that neither PTE nor GTE significantly predicted pupils' attitudes toward mathematics, $F(1, 38) = 1.83, p > .05$) and $F(1,38) = .03, p > .05$) respectively. The unique proportion of the variance in students' attitudes towards mathematics explained by personal efficacy was about 5% and by general efficacy was 0%.

Teacher Efficacy and Students' Achievement in Mathematics

Pearson correlation coefficients between teacher efficacy with students' achievement in mathematics were found to be moderately and significantly positive ($r = .36, p < .05$) but neither personal ($r = .29, p > .05$) nor general ($r = .25, p > .05$) efficacy significantly correlated with students' achievement in mathematics.

I performed two linear (enter) regression with achievement in mathematics as the dependent variable and the results are also presented in Table 7. Both the sense of personal teaching efficacy (8.63%, $R = .29$) and general efficacy (6.11%, $R = .25$) did not account

Table 7

Multiple Regression Results Using Teacher Efficacy to Predict Students' Math Attitudes and Achievement

Significant Predictor	R	R^2	F	Beta	T
			Math Attitudes		
General efficacy	.03	.00	.03	.-03	-.18
Personal efficacy	.21	.05	1.83	.21	1.83
			Math Achievement		
Personal efficacy	.29	.09	3.59	.29	1.89
General efficacy	.25	.06	2.47	.25	1.57

Table 8

Students' Attitudes Towards Mathematics as a Function of Students' Gender, Age, and Achievement Level

		Students' attitudes											
		Perception of teacher		Anxiety		Value		Selfperception		Enjoyment		Motivation	
Antecedents	n	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Gender													
Boys	668	26.1	4.45	16.5	4.27	26.4	4.21	22.5	4.20	24.0	4.09	23.3	3.62
Girls	802	26.0	4.95	17.0	4.51	26.1	4.35	21.8	4.36	22.7	4.31	22.5	3.37
Age													
15+	69	25.4	5.01	18.7	4.00	25.4	4.64	20.7	4.34	22.8	4.03	21.8	3.80
13-14	442	26.2	4.62	17.1	4.34	25.8	4.50	22.1	4.20	23.4	3.93	22.4	3.50
11-12	604	26.6	4.51	16.5	4.49	26.8	4.04	22.4	4.27	24.5	4.10	23.2	3.15
9-10	159	26.2	4.72	15.2	4.67	26.7	4.00	23.0	4.65	24.5	4.39	23.6	3.88
Achievement													
High	443	27.1	4.15	15.4	4.31	27.1	3.83	23.8	4.07	25.0	3.69	24.0	3.36
Medium	566	26.1	4.65	16.9	4.45	26.4	4.08	22.0	4.07	23.9	4.12	22.9	3.54
Low	465	24.9	5.09	17.8	4.12	25.2	4.71	20.6	4.11	22.6	4.46	21.6	3.89

In Table 8 reports the mean and standard deviations for each of the six scales in the mathematics attitude inventory are reported. Pupils in elementary schools held higher attitude regarding the usefulness of mathematical knowledge and the teaching characteristics of their mathematics teachers more than they did about enjoyment, self perception, and motivation to study mathematics. Correlation analysis showed that all attitudinal variables positively and significantly correlated with each other. There was a negative, weak but significant correlation between anxiety and total attitude ($r = -.15$, $p < .001$). The correlation coefficients among the attitudinal variables were all significant ($p < .001$). Multivariate analysis (MANOVA) and analysis of variance (ANOVA) were performed to compare the mean differences with respect to the different groups in the study.

Student's Gender

Means and standard deviations of attitudinal variables for boys and girls are reported in Table 8. The Table shows that girls expressed similar attitudes with boys in three of the six scales: anxiety, value, and enjoyment. The boys, on the other hand, had higher perception of the teachers and also had higher self perception of their own competence and reported higher motivation to study mathematics than girls. The Hotellings T^2-test found that there were significant gender differences in students' attitudes toward mathematics, T^2 (6, 1461) = 3.95, $p < .01$.

There were also significant gender differences in anxiety to study mathematics, $t(1466) = 4.82$, $p < .05$, self perception, t (1466) = 10.90, $p < .01$, and motivation, t (1466) = 15.86, $p < .001$. The boys scored lower in anxiety in mathematics, higher in self concept and motivation to study mathematics than the girls.

There were no statistically significant differences in their perception of teachers, t (1466) = .57, p > .05), value of mathematics, t (1466) = 2.00, p > .05, and enjoyment of mathematics, t (1466) = 1.75, p > .05).

Student's Age

Table 8 reports mean scores and standard deviations for each of the six scales of mathematics attitudes by age groups. From the Table it can be seen that children of all age groups reported the highest scores with respect to their perception of mathematics teachers and the value of mathematics in society, and scored lowest in self concept regarding their ability and their desire to study mathematics. Level of anxiety appeared to increase with proportional to age. While there was no apparent difference in the way they perceived their teachers, the younger the children were the higher the attitude they reflected regarding their self perception, enjoyment and motivation to study mathematics.

MANOVA yielded statistically significant differences in students' attitudes toward mathematics across the age groups, F (18,3785) = 4.30, p < .001. There were also significant differences in anxiety in mathematics, F (3, 1268) = 12.04, p < .001, value of mathematics, F (3, 1268) = 6.15, p < .001, self perception, F (3, 1268) = 5.21, p < .01, enjoyment, F (3, 1268) = 9.70 < .001, and motivation to study mathematics, F (3, 1268) = 8.23, p < .001 between pupils of different ages. There was no statistically significant difference between pupils of different ages in their perception of mathematics teachers, F (3, 1268) = 1.75, p > .05.

The Scheffe comparisons indicated that the pupils in the youngest age-group (9 to 10 year old) were significantly lower in anxiety than those pupils from other age groups. The pupils in the second youngest (11 to 12 year old) group were significantlty lower than those from the oldest age group (15 and older).

With regard to enjoyment of mathematics, pupils in the oldest group were significantly lower on enjoyment of mathematics than those in the two youngest groups while the 13- to -14- year olds were significantly lower on enjoyment than those of 11 to 12 years old.

With respect to motivation to study mathematics, pupils in the two older groups were significantly less motivated to study mathematics than the pupils from the two younger groups. Similarly, the two older groups felt significantly less competent than pupils in the two younger groups in their views regarding their own competence to study mathematics. As for their attitude regarding the value of mathematics, the 13-to-14 year old pupils perceived the value of mathematics to be less than the 11-to 12-year old.

Student's Ability Level

Table 8 reports the mean scores and standard deviations in attitudes of students within three ability groups. From Table 8, it can be seen that children from the three ability groups reported higher perception of their teachers and the value of mathematics in society but were lower in their perception regarding their own competence and desire to study mathematics than children from medium and low achievement groups.

MANOVA indicated that there were statistically significant differences in attitudes across the three groups, F (12,2926) = 15.02, $p < .001$. There were significant differences in students' views regarding perception of teacher, F (2,1469) = 25.26, $p < .001$, anxiety, F (2,1469) = 38.79, $p < .001$, value F (2, 1469) = 70.23, $p < .001$, self concept, F (2, 1469) = 22.26, $p < .001$ enjoyment, F (2, 1469) = 37.28, $p < .001$, and motivation, F (2, 1469) = 35.10, $p < .001$ between children from low, medium, and high placement.

Scheffe post hoc test showed that children who were low achievers felt more uneasy studying mathematics than students who were medium or high achievers. They were also lower in their attitudes regarding the teacher, value of mathematics, self perception, enjoyment, and motivation to study mathematics.

School Location

Table 9 reports the mean scores and standard deviations in attitudes toward mathematics for children in rural and urban schools. It can be concluded from the table that both the rural and urban school children reported high attitudes for their teachers and value of mathematics in society but low attitudes regarding their perception of their ability to study mathematics. The Hotellings T^2-test produced statistically significant differences in attitudes between rural and urban pupils, T^2 (6, 1465) = 18.68, $p < .001$. There were significant differences between pupils in rural and urban schools in each of the six scales: perception of teacher, t (1470) = 58.16, $p < .001$), anxiety, t (1470) = - 21.67, $p < .001$), value, t (1470) = 61.60, $p < .001$), self concept, t (1470) = 8.10, $p < .01$), and motivation, t (1470) = 9.42, $p < .01$). The urban children scored lower in anxiety to study mathematics than rural children, and significantly higher on the other five attitudinal scales.

Level of School Achievement

Differences in attitudes by school achievement levels are reported in Table 9. In the Table, the students from schools with higher achievement placement scored higher in attitudes than those from schools with low achievement. All children from the three categories of schools expressed low feelings regarding their own competence to study mathematics. MANOVA results indicated that there were significant differences in students' attitudes toward mathematics between pupils from schools with different achievement levels, F (12,2926) = 16.35, $p < .001$. Differences also emerged in their attitudes regarding their teachers, F (2, 1469) = 53.40, $p < .001$, anxiety, F (2, 1469) = 40.17, $p < .001$, value, F (2, 1469) = 53.60, $p < .001$, self perception, F (2, 1469) = 14.62, $p < .001$, enjoyment, F (2, 1469) = 50.89, $p < .001$, and motivation, F (2, 1469) = 14.74, $P < .001$.

Scheffe comparisons indicated that pupils from schools with high achievement were less anxious to study mathematics than were pupils from schools with medium and low achievement. Similarly, pupils from schools with low and medium achievement were lower in attitude regarding perception of the teacher, value, self perception, enjoyment and motivation to study mathematics than those from schools with high achievement.

Summary

Across all groups, scores in students' perceptions about their teachers and value of mathematics to society were significantly higher than scores in other dimensions of attitude. Anxiety correlated negatively with other dimensions and appeared to decrease as the others increased and had the strongest significance. Significant differences were noticed in most of the attitudinal variables: anxiety, self perception, enjoyment of mathematics and motivation to study mathematics.

Table 9

Students' Mathematics Attitudes as a Function of School Location and School Achievement Level

		Students' attitudes											
		Perception of teacher		Anxiety		Value		Selfperception		Enjoyment		Motivation	
Antecedents	n	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
School location													
Rural	417	24.5	4.80	17.6	3.98	24.9	4.47	21.6	4.19	22.2	4.20	22.4	4.04
Urban	1057	26.6	4.56	16.41	4.53	26.8	4.09	22.32	4.34	24.4	4.06	23.1	3.54
School Achievement													
High	805	27.2	4.32	15.9	4.47	27.2	3.70	23.8	4.24	24.8	3.91	23.4	3.34
Medium	324	25.0	5.25	17.9	4.50	24.8	5.00	21.2	4.88	22.4	4.56	22.3	4.24
Low	340	24.4	4.43	17.7	3.68	25.3	4.19	20.8	3.65	22.8	3.94	22.3	3.71

Antecedents of Student's Mathematics Achievement

Means, standard deviations and t values and F values in achievement in mathematics were computed for gender, age, ability level, location of school and school achievement level.

Student's Gender

Mean achievement scores for boys and girls are presented in Table 10. A t-test shows that the boys were statistically significantly achieving higher than girls $t(1104) = 2.20$, $p < .05$.

Student's Age

Age of the students was found to correlate negatively with students' achievement in mathematics ($r = -.16$, $p < .001$). From Table 10, it can be seen that the younger pupils scored higher in their academic performance in mathematics than the older pupils, and comparisons about achievement in mathematics using ANOVA produced significant age differences, $F(3,910) = 9.96$, $p < .001$. The Scheffe test showed that the two younger groups performed significantly better than the two older groups.

Student's Ability Level

With regard to achievement level of students, correlation analysis showed a moderate, positive correlation between teachers' categorization of student ability placement with actual achievement in mathematics ($r = .49$, $p < .001$). Table 10 shows that the higher the achievement level of placement of the pupils, the higher was their achievement in mathematics. ANOVA yielded statistically significant difference between pupils of the three achievement groups in the study, $F(2, 1103) = 176.33$, $p < .001$. Scheffe tests of significance show that students in low and medium achievement placements were significantly lower in achievement than those in high placement and those of low placement were also lower than those in medium placement.

Table 10

Students' Mathematics Achievement as a Function of Students' Gender, Age and Achievement Level

	Math achievements		
Antecedents	n	M	SD
Gender			
Male	520	44.6	23.51
Female	606	41.0	22.57
Age			
15+	44	30.7	23.80
13-14	312	40.5	24.54
11-12	475	47.9	22.83
9-10	93	49.4	20.46
Ability			
High	337	53.1	21.50
Medium	429	35.5	18.74
Low	340	23.3	17.95

Location of School

Results for achievement differences between urban and rural pupils are shown in Table 11. Generally, achievement scores were higher for urban pupils than for rural pupils.

The t-test showed that there was a significant difference between urban and rural pupils in favor of urban pupils t (1104) = -5.70, p < .01.

Table 11

Students' Math Achievement as a Function of School Location and School Achievement Level

	Math achievements		
Antecedents	n	M	SD
School location			
Rural	306	35.2	15.82
Urban	800	45.5	23.97
School Achievement			
High	583	59.4	22.01
Medium	236	40.91	19.24
Low	287	28.3	17.25

Level of School Achievement

With regard to school achievement level, Pearson correlation analysis showed that there is a moderate significant correlation with students' achievement in mathematics (r = -.43, p < .001). Table 11 shows that achievement in mathematics seemed to increase proportionally. The higher the school achievement level, the higher were the achievement scores of the pupils. ANOVA showed that there were significant differences in achievement between pupils from schools rated with low, medium, and high achievement, F (2, 1103) = 125.80, p < .001.

Scheffe comparisons showed that the students from schools with low and medium achievement performed significantly lower than those from schools with high achievement. Similarly those from schools with low achievement were also weaker than those from schools with average achievement.

Summary

There were significant differences in achievement in mathematics with the younger pupils, the boys, and those with high ability as well as those in schools with high achievement scoring higher than the older students, the boys, those with lower ability, and those in schools with low achievement, respectively.

Relationships Between Attitudes toward Mathematics and Achievement in Mathematics

Pearson correlation and multiple regression analyses were performed between attitudes toward mathematics and achievement in mathematics. There existed a significant correlation between total scores in attitude and achievement ($r = .34$, $p < .001$). Achievement correlated positively with all other attitudinal variables except anxiety ($r = -.34$).

Multiple regression analysis (see Table 11) with attitude toward mathematics as the independent variable in order to predict achievement in mathematics showed that the joint effect of all the attitudinal variables on achievement was significant, $F(6, 1096) = 44.83$, $p < .001$. On the average, 19.70% ($R = .44$) of the variance in mathematics achievement was due to attitudes held by students toward mathematics. Anxiety (Beta = -.34) was the strongest significant predictor of achievement, accounting for 11.38% of the variance in achievement in mathematics, while motivation to study mathematics (Beta = .06) was the weakest predictor of achievement in mathematics.

Table 12

Students' Math Attitudes as a Predictor of Math Achievement

Significant Predictor	Beta	F	R	R^2	T
Perception of leader	.32	124.86	.32	.10	11.2***
Anxiety	-.34	141.6	.34	.11	-11.9***
Value	.29	99.3	.29	.08	10.0***
Selfperception	.32	126.4	.32	.10	11.2***
Enjoyment	.33	138.7	.33	.11	11.8***
Motivation	.25	71.1	.25	.06	8.4***
Interaction	.44	44.8	.40	.20	11.1***

Note: Beta standardized equivalent partial regression

*** $p < .001$

Summary

Attitude towards mathematics is a significant predictor of achievement in mathematics although the variance is low. Anxiety is the most significant single attitudinal variable predictor of achievement. Measures of teacher efficacy are weak and are not significant predictors of students' attitudes toward mathematics and achievement in mathematics.

CHAPTER 6: DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

This study investigated the model of teacher efficacy in order to examine (a) teacher efficacy and its antecedents, (b) the relationship between teacher efficacy and teachers' perceptions of instructional strategies as well as their teaching styles and classroom organization, (c) the relationship between teacher efficacy and students' attitudes toward mathematics and their achievement in mathematics, (d) antecedents of students' attitudes toward mathematics and their achievement in mathematics, and (e) the relationship between students' attitudes toward mathematics and achievement in mathematics.

The study partially provides support for the teacher efficacy model developed for the study. The model was not fully supported with respect to antecedents of teacher efficacy but received great support with the relationships between teacher efficacy and teaching behavior and student outcomes. The model was also supported with antecedents of students' attitudes toward mathematics, achievement in mathematics and their relationship.

Discussion

Antecedents of Teacher Efficacy and Teacher Behaviors

The findings that emerged from this study cast doubt on the questions about antecedents of teacher efficacy and differences in teacher efficacy. There were no significant differences in both personal and general efficacy of the teachers with regard to gender, level of training of teachers, amount of teaching experience, and school achievement level.

Antecedents of teacher efficacy. Although the findings were no statistically significant, the results may indicate a trend that supports the results in previous studies (e. g. Armor et al, 1976; Ashton et al. 1983). These studies showed that higher scores in personal efficacy than general efficacy show that most teachers tend to think that they have skills and abilities to bring about student learning and consequently help pupils achieve well in mathematics. The high personal efficacy teachers did recognize their personal responsibility in student learning, achievement and / or behavior.

Teachers' gender did not have an effect on their sense of efficacy. Traditionally males have been found to show higher efficacy or personal efficacy. The lack of gender differences indicate that being a female teacher does not impede one's potential to affect student learning and success. This finding is in contrast with Greenwood et al. (1990) who reported that gender difference exists with regard to teacher efficacy. The findings of this study also contradict the results reported by Evans and Tribble (1986) who suggested that female teachers had greater personal and general efficacy than male teachers. Goldman and Hewitt (1976) also reported results that found lower efficacy in women. Possible reason for the lack gender difference is because teaching is traditionally considered to be women's profession where they are confident.

Level of teachers' education did not have an impact on efficacy. The expectation would have been that those with higher training would see themselves more capable to affect student learning and achievement. The results reported in this study imply that the level of training is not an important factor in enhancing feeling of efficacy among teachers.

This finding contrasts with reports by Cooper and Robinson (1991), Benz et al. (1992) and Lent et al. (1991) whose studies suggested that teachers who feel less effective may not have been trained. Similarly, the study does not support the results reported by Hoy and Woolfolk (1990) who found that personal efficacy was higher among practising teachers with extra graduate courses.

Teaching experience did not have an impact on teachers' feeling of efficacy. It was surprising that personal and general efficacy had low and negative correlation with teaching experience ($r = -.03$ & $-.11$) respectively. This finding shows that teaching experience decreased the likelihood that teachers would believe they could motivate difficult students and promote a sense of ability. It would be expected that the more experienced teachers woud show stronger personal or general efficacy because of experience.

The lack of difference in efficacy feeling between the more and less experienced teachers could be attributed to the general frustration that the more experienced teachers seem to go through due to lack of job satisfaction in the teaching profession. The longer they teaching, the more frustrated the teachers seem to be. The reason may be attributed to the low salary that is paid to teachers compared to other professions. This finding does not corroborate the results reported by Dembo and Gibson (1985) who found that entering teachers (in N.America) have stronger personal efficacy than long term teachers.

There was no significant difference in efficacy between field and preservice teachers, although raw scores indicated that field teachers scored higher than preservice teachers in personal efficacy. The results seem to indicate that the prefield teachers appeared more confident in their abilities to motivate pupils more than field teachers. This result seems to indicate that teachers' sense of personal efficacy becomes greater as a result of student teaching while general sense of efficacy seems to decrease after teaching. This finding does not agree with some of the earlier researches such as Hoy and Woolfolk (1990), Brown (1982), and Evans and Tribble's (1986) who reported that preservice teachers had higher sense of efficacy than field teachers.

The results of this study showed that efficacy of teachers was not influenced by school achievement level. The correlation between efficacy and school achievement level was negative and not significant. The finding from this study contrasts those of Ashton and Webb (1984), Guskey (1988), and Evans and Tribble (1986) with the conventional expectation that teachers in schools with low achievement are likely to express low general efficacy than personal efficacy.

The findings of the study do not underscore the independence of personal efficacy and general efficacy because the correlation between the two dimensions was low ($r = .24$, $p < .05$). This finding is in contrast with Hoy and Woolfolk (1990, 1993) who had reported that the two dimensions are inversely correlated and are therefore, independent.

Teacher efficacy and teachers' behavior. Regression weight for personal efficacy (Beta = .34) to predict teachers' total perceptions of the use of instructional strategies was close to that of general efficacy (Beta = .35). Personal efficacy's prediction of teachers' beliefs about content-oriented strategies was similar to general efficacy's prediction, while general efficacy was higher in predicting teachers' belief about cognitively-oriented strategies. The expectation is that the choice of teaching strategy would be influenced by one's sense of personal efficacy; that is, a greater commitment to cognitively oriented strategy would be expected among teachers who believe student achievement can be influenced through skillful instruction. Hence, teachers may have confidence in their ability to influence achievement and assume personal responsibility for the level of student achievement. This finding agrees with Bandura (1986, 1987) who said that efficacy belief affects whether one will initiate specific behavior but contrasts with Gibson and Dembo (19840 who viewed PTE as the best predictor of teacher behavior.

This finding also implies that both the sense of personal and general efficacy would influence the teachers' choice of what type of instructional strategies to use. It appears that teachers with greater personal efficacy would have greater preference for the use of cognitively oriented strategies while teachers with greater sense of general efficacy would prefer content-oriented strategies. One lokely explanation for this finding may be due to the general dissatisfaction most teachers in Uganda do experience within the profession especially due to low salaries compared to those in other professions. They would even questioned their professional competence. This result corroborates the result reported by Mackenzie (1987) who found that teacher efficacy can be used to predicts teachers' implementation of innovative programs and student achievement.

The differences in teaching behaviors between teachers of high and low efficacy were evident, though not uniform. The teaching strategies of the high efficacy teachers were characterized by cognitively-oriented strategies while for low efficacy teachers by content-oriented strategies. Feelings of high efficacy seem to motivate and lead teachers to a greater willingness to try a variety of teaching methods that can improve students' understanding of mathematics concepts.

One possible explanation for the difference in teaching styles and classroom organization between high and low efficacy teachers may be due to the fact that high efficacy teachers were confident of their own ability, believed and reflected a strong academic orientation and effective teaching (Brophy & Good, 1970; Cronin, 1986; Gibson and Dembo, 1984). The high efficacy teachers were motivated by school organization through Parent/teachers association (P.T.A) which paid them reasonable remuneration. This finding supports earlier research by Armor et al. (1976), Ashton and Webb (1986), Ashton et al. (1983), Gibson and Dembo (1984), Podell and Soodak (1993), Woolfolk and Hoy (1990) and Woolfolk et al. (1990) that found behavioral differences between low and high efficacy teachers in their teaching styles.

Differences were noticed in class organization and management whereby high efficacy teachers were better organized than low efficacy teachers. They appeared more friendly to pupils, utilized personal rather than positional authority in classroom management, and were stable and felt confident, unlike the teachers of low efficacy. These findings confim the work of Ashton and Webb (1986), Meyer (1985) and Tomic (1992).

However, teacher behaviors and general learning organizations that were observed in the classroom were not consistent with teachers' reports from questionnaires and interviews. All the teachers reported that they used a combination of methods to teach but their responses from questionnaires showed no significant diffferences.

Teacher efficacy and student outcomes. Teacher efficacy did not significantly predict students' attitudes toward mathematics and achievement in mathematics. The contribution of personal efficacy (Beta = .21) to students' attitudes toward mathematics was stronger than that of general efficacy (Beta = .03). Similarly, the variance for achievement accounted for by personal efficacy (Beta = .29) was greater than that explained by general efficacy (Beta =.25). Teachers' sense of personal and general efficacy did not significantly predict students' attitudes toward mathematics and achievement in mathematics. This result can be explained in terms of the likely difference in the influence of personal and general teacher efficacy. Personal efficacy teachers would be more likely to influence attitude and achievement than general efficacy. Therefore, the contention that students' achievement would be higher in the classrooms of teachers with personal efficacy (r = .29) than general efficacy (r = .25) was confirmed (Ashton & Webb, 1986) who reported that teachers with high personal efficacy would expect students to learn and achieve well.

The findings from this study, however, agree with Hillman who found that sense of teacher efficacy had a small effect on students' achievement but do not support Tracz and Gibson (1986) who stated that GTE correlates significantly with students' mathematics achievement. The result of the study also implies that attitude and achievement are not meaningfully related with teacher efficacy. This finding does not agree with results reported by Relich et al (1986), Armor et al (1976), Ashton et al (1983), Brookover et al. (1978), Brophy and Evertson (1977) and Gibson and Dembo (1984) who found that the greater the sense of efficacy, the more the students advanced in achievement; and also that general efficacy was significantly related to achievement in mathematics while personal teacher efficacy was significantly related to language achievement. These findings also support Anderson et al (1988) who asserted that personal efficacy predicted student achievement in language reading and mathematics in grades 3, and notin grade 6.

Summary. Gender, training level of teachers, teaching experience, and school achievement do not seem important determinants of teachers' sense of efficacy. Teacher efficacy is a significant predictor of teachers' beliefs about the use of different instructional strategies in mathematics. Teaching behavioral differences exist between teachers of high efficacy and low efficacy in their teaching strategies and classroom organization. Sense of efficacy significantly predicts teachers beliefs about the use of instructional strategies. Teacher efficacy does not significantly predict students' attitudes toward mathematics and their achievement in mathematics.

Students' Attitudes Toward Mathematics and Achievement in Mathematics

As predicted, there were significant differences in students' attitudinal variables. Pupils generally tended to have higher attitude toward their teachers and the value of mathematics in society than they had regarding their ability to study mathematics. Anxiety appeared to decrease as the other attitudinal variables appeared to increase ($r = -.15$, $p < .001$). All attitudinal variables except anxiety were significantly and positively correlated with each other and with mathematics performance as measured by the end of the second term exams. Students who felt uneasy in mathematical situation did manifest lower scores in other dimensions of attitudes toward mathematics, and performed relatively weaker than those who manifested less anxiety in mathematics.

A number of possible explanations can be offered for the differences in attitudes toward mathematics. These factors include intellectual, social, parental, curriculum, and teacher factors (differences in teaching organization) (Aiken, 1974; Skemp,1976; Stigler, 1986, 1990), lack of perceived relevance of mathematics (Boulton-Lewis et al, 1991), the belief that mathematics is a difficult subject, parents and peers' attitudes, school climate and cognitive, affective, and motivational differences (Sandman, 1980). It would be expected, for example, that effective teachers who explained well, were sympathetic, enthusiastic, had strong interest in mathematics and teaching, showed desire to have students understand, and administered flexible class control without being overly strict would encourage students to like mathematics (Aiken, 1974).

Findings related to mathematics anxiety are consistent with those of previous studies. Anxiety negatively correlated with all other attitudinal variables as well as with achievement. It appears anxiety may be a critical barrier to success in mathematics (Dwindell & Higbee, 1991).

Mathematics achievement results are not surprising since much previous research has shown differences exist. There were significant differences in achievement by age, gender, school location and achievement and school achievement level. Differences in achievement in mathematics could have been due to teacher characteristics (e.g. teaching experience and educational background, teacher's belief and teachinf effectiveness), attitudes of students towards mathematics, school organization, parents' expectations, and many affective and motivational factors (Evertson, Emmer & Brophy, 1980)

Signifcant gender differences in attitudes toward mathematics, though small, were noticed in favor of boys in three areas: mathematics enjoyment, self-perception and perceived usefulness of mathematics to society. Gender differences in student perceptions of themselves as learners of mathematics seem to have been normal. The gender differences observed in this investigation are consistent with sex stereotyping (Betz & Hackett's, 1981) that males consistently have stronger beliefs in their ability to perform everyday mathematics-related tasks than females. Gender difference in anxiety did not emerge which shows that not all females are anxious nor are all males confident in their ability to study mathematics. This finding contradicts the result reported by Betz (1978) that females have tended to report higher levels of mathematics anxiety than males.

The gender difference in achievement in mathematics was also noted in favor of boys. The reasons for relatively poor performance of girls could well be accounted for in terms of anxiety, lack of parental encouragement, teacher influence, stereotyping. Girls were likely to attribute their lower achievement to lack of ability. The results of this study support the findings of Ewess and Wood (1992), Skaalvik (1990), and Benbow and Stanley (1983) , and Fennema and Sherman (1977) who found that males tend to outperform females but this result contrasts with Robinson (1975) who found no significant difference in achievement between boys and girls. Attitude in females can also be a barrier to success in mathematics (Boswell & Katz, 1980; Anderson & Thorpe, 1992). Stevenson et al (1990) warned that lower level in achievement in mathematics cannot be explained in terms of attitudes.

Age differences in attitude toward mathematics noticed in all attitudinal variables except in their attitude regarding the mathematics teachers. Pupils who were younger tended to manifest more positive attitudes toward mathematics and they were less anxious to study mathematics. Age correlated negatively with anxiety ($r = -.16$), self perception ($r = -.10$), and enjoyment of mathematics ($r = -.13$). The older the pupils, the less they felt they were competent in mathematics and the less they enjoyed studying mathematics. These results are consistent with those obtained by Holloway et al. (1990) who suggested that attitudinal differences can be detected to a greater extent between the ages of 13-15. This result also supports Aiken (1970) who asserted that attitudes are formed as early as the third grade and begin to grow negatively in the later primary and early high school periods.

Age differences in achievement in mathematics were also evident. The younger children performed better than the older ones possibly because the younger ones are not yet disturbed by social problems and they concentrate, listen to teachers' advice and work hard. This finding is in agreement with Brush (1985) who found that age of children influences achievement in mathematics. It is, however, not known if the younger ones knew more mathematics than the older ones.

There were significant differences in all attitudinal variables and achievement in mathematics between pupils of the three achievement placements. All other variables except anxiety appeared to increase while ability levels of students decresed (r = -.22). This occurrence suggests that anxiety is inversely correlated with learning context (i. e. being a student in low ability. Low achievement seems to raise anxiety and reduce students' proficiency.

This difference in attitude and achievement in mathematics with respect to students' achievement level may be explained in terms of level of hard work, intelligence, and interest in mathematics and sociometric grouping of students. Low achievers performed poorly because they may have no idea of what to do (Sternberg, 1986). It could also be because of language difficulty or poor language development (Vygotsky, 1978; Luria, 1978) which tends to be experienced by low achievers, which hampers their effective understanding of concepts in mathematics.

Lack of attitude and achievement in mathematics also differed in the three types of schools studied. Differences favored children in schools with high achievement which were predominantly urban schools. The favorable urban climate such as availability of peace, teaching materials, lunch services, and a variety of stimulating materials may provide favorable school climate, which in turn, support student achievement, students engage in more productive and stimulating behavior, and they feel satisfied with schooling. Positive effects of high SES in urban parents may have contributed to positive attitudes toward schooling and thus enhance ppupils' academic performance. Urban pupils are also exposed to coaching more than rural pupils, which facilitates more understanding of concepts.

This finding corroborates the results reported by Holloway et al (1990) and Reynolds and Walberg (1992) who found that SES is a significant predictor of mathematics achievement. Schools with high achievement offer stimulating working and learning conditions for teacher and pupils, respectively. This includes average work load per week for teachers, adequate special remuneration such as the PTA booster, and availability of a variety of instructional tools. Schools with historically poor academic achievement tend to have teachers who report poor image of school atmosphere which contributes to poorer teaching effectiveness. These observations support Moore (1994).

Schools in Uganda with high achievement have many teachers with reduced workload which gives them time to plan and synthesize what they will teach. This observation corroborates McKnight et al. (1987) and Heyneman and Loxley (1983) whose findings reported that teachers in the United States face heavy workloads compared to those in Japan and this leads to United States children performing poorer in mathematics and have low conceptual understanding than Japanese children.

In spite of the often expressed belief that attitude and achievement are meaningfully related, it appears from this study that low causal relationship exists between attitude and achievement. Coefficients of correlation between achievement and attitude were generally modest, positive and significant (r = 29 to .34). Achievement in mathematics was moderately and negatively correlated with anxiety (r= -.34) but positively with student belief about the importance of mathematics to society (r = .29), attitude about the teacher (r = .32), enjoyment of mathematics (r =.33), students' own competence in mathematics (r = .32), and motivation to study mathematics (r = .25). Inhibition produced by mathematics anxiety appeared to swamp any motivating effect . This finding is in agreement with Aiken (1974), Neale (1969) and Hackett and Betz (1989) whose study reported positive significant correlations between attitude and achievement but contradicts Robinson's (1975) finding which indicated that the two were not correlated.

This study reported that attitudes toward mathematics significantly predicted achievement in mathematics. Not only were the zero order correlations significant but the beta coeficients in the regression analysis demonstrated that both academic achievement in mathematics and attitudes toward mathematics were significant. Although attitude explains only 19.70 % of the variance of relationship with achievement, a relationship exists which shows that attitude is an important factor in achievement. Anxiety is one of the attitudinal variables that made a significant negative contribution to the proportion of variance in achievement. The finding of the study supports the research by Dwinell and Higbee (1993) but contrasts the work of Norwich and Rovoli (1993) which stated that attitude is not a good predictor of student behavior and achievement.

Summary of students' math attitudes and achievement. There were significant differences in students' attitudes toward mathematics in most antecedents except gender. Differences in achievement emerged by gender, student ability level, school location and school achievement level. Attitudes were significant predictors of achievement in mathematics. Anxiety is the strongest predictor of the attitudinal variables.

Conclusions

This study examined the results of a cross sectional analysis a study focusing on teacher efficacy and its relationships with teachers' beliefs about the use of instructional strategies in mathematics, actual strategies teachers used, students' attittudes toward mathematics, and their achievement in mathematics. The findings from this study lead to the following conclusions:

1. The study has not identified fundamental indicants of teacher efficacy. There were no gender, amount of teaching experience, training level, school location, and school achievement level with respect to personal and general efficacy. Although teachers scored higher in personal efficacy than in their belief regarding the use of general efficacy, no statistically significant difference emerged.
2. There does not a relationship between teachers' sense of efficacy beliefs and teaching experience, gender, school achievement level, and training level of teachers.
3. Teacher efficacy significantly predicted teachers' perception of the use of instructional strategies. Personal efficacy was a stronger predictor than general efficacy.
4. There were significant differences in attitudes toward mathematics and achievement in mathematics of elementary school pupils. Students' perceptions of their teachers and the value of mathematics were higher than others. Except anxiety, all other measures of attitude were positively correlated with each other.

5. Correlation coefficients between achievement and attitudes were modest in general and significant. Achievement correlated with attitude positively but negatively with anxiety.

6. The younger the pupils, the higher was their attitude toward mathematics and achievement in mathematics performance were more positive toward mathematics and lower in anxiety than the older ones.

7. Boys scored higher on attitudes toward mathematics and performed better than girls but there was no difference in their feelings of confidence, motivation, and anxiety in mathematics.

8. Attitudes and achievement scores were not equal among the three categories of pupils and in the three types of schools studied. Differences favored pupils who were in high achievement placement and from schools with high achievement.

9. There existed moderate, significant correlation between attitude and achievement in mathematics. Attitude toward mathematics significantly predicted achievement in mathematics with anxiety ranking the highest predictor while motivation was the lowest predictor of achievement.

10. Significant correlations between teacher efficacy and students' attitudes towards mathematics and a significant moderate correlation with achievement emerged.

11. High efficacy teachers were more effective classroom teachers and used more cognitively-oriented strategies in mathematics teaching than low efficacy teachers.

Implications and Recommendations

This study was designed to investigate relationships among variables rather than prove causality. Although some statistical tests were conducted, the results should be considered for their exploratory value rather than a proof of causal relationships between variables. This study suggests a number of implications for teachers, researchers, educators, and curriculum developers.

1. Teacher demographic and situational information (gender, training level, teaching experience, school location, and school achievement level) did not appear to have important effect on teacher efficacy. Therefore, more information about the antecedents of teacher efficacy is needed if teacher educators and administrators are to find this concept useful in practice as well as in research. Questions such as " can teachers be trained to be more efficacious, how and when can such training be implemented?" need to be answered. At this point, much remains to be investigated about teachers' sense of efficacy and its impact on improving teacher performance.

2. Data collected rom the study through oral interviews suggest that the sense of personal teaching efficacy is a consequence of meeting instrumental needs of teachers such as morale, job satisfaction, and emotional support which should be enhanced right from college through to the field. School systems need to provide working conditions that will held to raise the morale of teachers and lead them motivated and commited to the profession. However, it may be too ambitious to expect that any teacher training program will produce beginning teachers with firmly established sense of personal teacher efficacy. Realistically, a more reasonable goal might be to help teachers develop skills and knowledge that are instrumental in accomplishing day-to-day teaching. Administrators should evaluate policies and procedures to assign teachers to teach mathematics in certain classes.

3. Efficacy was found to be related to teachers' beliefs and actual teaching. The finding supports the contention that teachers' sense of efficacy is a significantly related to teacher's classroom organization in mathematics. However, these effects may differ across different subjects.

4. Stability of sense of efficacy should be explored to find out if efficacy is situation-specific and likely to vary from setting and time.

5. To gain a better understanding of the role of teachers' conceptions of mathematics teaching, more research to examine prevalence and stability of teachers' conceptions of mathematics instruction should be conducted.

6. Knowledge about instruction, learning and achievement in mathematics makes it clear that how mathematics is taught has effect on students' attitudes and achievement in mathematics. Therefore, preservice and inservice training need to devote attention to instructional problems beyond focus on initial presentation of content and the utilization of concrete materials. Additional attention needs to be given to strategies used suitable for a particular content. Educators should pay attention to teacher selection and training, and to the possibility of taking into account teacher characteristics. It is not advantageous to recruit into a noble profession, like education, those who are fundamentally with the poorest academic achievement grades at the high school (O & A levels).

7. Bandura (1981) suggests that self efficacy can be enhanced through modeling and successful mastery experiences through micro teaching and field experiences. It is not enough for a program to rely on practicum only as field experience. Organized field trips for either academic and/or leisure might prove to be advantageous facilitate deeper grasp of mathematics concepts which might help to make them more effective teachers.

8. The scope and sequence of the curriculum in mathematics needs be re-designed to reflect students' ability and maturity, and relevance to society. The National Curriculum Development Centre (NCDC) might need to investigate this issue because some topics appear to be prematurely introduced in certain classes. Some topics were cited by several teachers and pupils to be irrelevant, meaningless and are unnecessarily difficult to teach and perceive. The curriculum reorganization needs to be accompanied by changes in school organization, student readiness, effective teacher training, and parental education.

9. Preservice units on girls' education in mathematics could be developed for prospective teachers. Gender equity guidelines for mathematics and science curricula committee might be essential to assist teachers in the best possible ways of making mathematics meaningful to girlsat all levels. Examples that teachers give and their meaningfulness should be looked into. Use of examples in textbooks from the world of boys' experiences and interests tends to make girls feel peripheral.

10. Inservice and refresher intervention programs could be mounted constantly especially during the holidays. While other teachers may be required to go for political and military education programs (*mchaka-mchaka*) some mathematics and science teachers could go for refresher courses (1-2 weeks). The administrative organization could be worked out to conveniently suit all the parties concerned. The objectives of these programs may, for example, be:

(a) to help teachers examine their own expectations of girls and boys in mathematics/science,

(b) to develop teachers' awareness of socio- cultural factors which are contributing to underachievement in mathematics (science) - more particularly, girls and students in rural areas.

Programs could address factors in the classroom / school which reinforce teacher influences (e.g. classroom management, class-size, student and teacher interaction, improving instructional focus, and presentation of materials). Such programs could enable teachers and planners to address philosophical and practical problems affecting the teaching and learning of mathematics (science), and

(c) to assist teachers to promote students' and more particularly girls' interest and competence in mathematics (science).

Teachers at all levels must be well grounded in mathematics and at the same time familiar with the interface between mathematics and other subjects. They may need initiative to work with other teachers and parents and the community in planning the courses that are relevant, specifically for their students. Inservice and preservice education should incorporate these perspectives. Experimental courses in mathematics could be developed for students who exhibit mathematics anxiety (avoidance syndrome). These courses could address the anxiety problem as well as mathematics instruction skills to eliminate mathphobia in students.

11. Findings suggest that teachers should be exposed to self concept enhancement and anxiety reduction strategies in mathematics context; that sense of efficacy is a consequence of multiple variables such as job satisfaction, school climate, relationship with colleagues, and general morale and it is important to the psychological well-being of teachers.

12. Most researchers have tended to concentrate in major urban centers like Kampala, Jinja, Mbale, for example, and their rural hinterlands. Further research, therefore, could be conducted to replicate this study on larger popupations in both rural and urban areas, including isolated and remote corners such as Kitgum, Moroto, Kasese, Bundibugyo, Kapchorwa, Kisoro, Rukungiri, Ntungamo, and Rakai.

Further research could be done to determine if teachers with improved efficacy do achieve higher teaching competence and could also consider comparing attitudes and achievements of larger groups of students on a cross-sectional study (i.e. primary, secondary, colleges, and universities). More particularly, researchers could analyse achievement in mathematics section by section in order to assess which areas in mathematics are most or least difficult to most of the pupils.

Both mathematics and non mathematics students could be studied and compared.

A longitudinal study could also be undertaken to determine the trend or pattern of change in attitudes and achievement in mathematics as well as other subjects. Teachers could be encouraged and assisted to conduct research in their own schools. Further research could be done in which boys and girls are matched for abilities, age, grade, and other cognitive, affective, and environmental factors such as SES and religion. Clear directions for future research could employ sophisticated analytical tools and models such as those that can control two or more variables at a time so that many fundamental variables are not ignored.

Data from questionnaires, interviews, and observations were not complementary, but rather contradictory. This implies that results from quantitative and qualitative research could be used to establish active dialogue by identifying the most effective way of exploring a research problem.

13. While researchers question the theoretical nature of efficacy, reformists might view the construct as a policy-relevant alterable characteristics of educational context. An indigenous, culturally dictated model of curriculum could be developed with topics that are related to students' mental abilities and could be blended with western technological model such as computer-based instruction, interactive classroom with expanded model of communication, cognitive based instruction (cooperative) and strategy development.

14. It might be useful to introduce ethno-mathematical perspectives into mathematics curriculum. Hence, mathematics educators should recognize students-out of school mathematical experiences (their own ethnomathematics). The entire mathematics curriculum should be restructured so that mathematical and ethnomathematical concepts are synthesized. Rather than a curriculum emphasizing many isolated skills, mathematics education should embody real life applications in the form of projects based on themes and real ideas.

15. Teachers should be encouraged to work together, share the teaching of classes and topics based on interest and ability. This would help to enhance their levels of efficacy by reducing confrontation, blames and unhealthy criticisms among teachers. Rather, it would encourage and consolidate transparency, sharing of responsibilities among teachers, and accountability to achieve the desired goals.

16. Data from oral interviews with teachers and pupils indicated that success in mathematics also depends on previous mathematics achievement . The tendency has always been for lower classes teachers to teach very little content and reach upper classes with

inadequate background knowledge. Respective teachers in different classes should endeavor to ensure that pupils acquire basic skills and achieve well in mathematics before they proceed to the next class. Lack of adequate achievement leads to loss of career potential in the future. Systematic intervention programs which can positively influence attitudes of children could be incorporated into teaching programs and mathphobia (mathematics anxiety) be reduced. Such intervention programs should focus on content of mathematics and teaching students to deal with mathematics anxiety effectively. Strategies such as systematic desensitization, cognitive restructuring, and school counselors programs may be employed for anxiety reduction. The mathematics teachers may also try to incorporate strategies that facilitate success in classroom.

17. Schools need to broaden their assessment schedules to include aspects of mathematics power, mathematical thinking, measurement sense, number sense, operation sense, and factors of attitudes, spatial skills, and co-curricula activities. It should be noted, here, that government in the Government White Paper (1992) has strongly highlighted this idea and would like to see it implemented soon. Girls, slow learners, and the disadvantaged may need intervention or enrichment courses in mathematics to compensate for their lack of performance. This intervention work could be achieved by re-organizing single sex groups, if necessary. Parents and teachers may need to be encouraged to change their beliefs and attitudes toward expectations of girls. Educators need to communicate to, and educate parents about the nature of effect they (parents) have on children's educational achievement. There might be need for active encouragement of girls to take more mathematics and avoid too much political rhetorics (theorizing) about women's rights, confrontational approach which has forced men to become defensive.

18. Educators must challenge simplistic policy prescriptions that are not supported by valid research data. There is need for strong pedagogical institutional, familial and sociocultural forces that also shape achievement.

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APPENDIX 1

Department of Educational Psychology Ethics Review

Department of Educational Psychology Ethics Review

Description of Project and Procedures for Observing Ethical Guidelines

PLEASE PROVIDE 2 COPIES OF THIS DOCUMENT TO THE CHAIR, RESEARCH COMMITTEE, DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

Project Title: Teacher Efficacy, Teachers' and Students' Perception of Instructional Strategies in Mathematics.

Project Deadlines:

Date by which project approval is desired: April 12th 1994.

Starting Date: May 1st 1994 **Ending Date:** Sept. 30th 1994

Applicant(s):

Principal Investigator: Julius S. Caesar Enon

University Status: Graduate Student

University Address: Dept. of Educ. Psychology

University Telephone: N/A

If the principal investigator is a student, please provide the following information:

If the research project is for a thesis or dissertation, has the applicant's Supervisory Committee approved the project? Yes: ✓ **No:** ____

Name of Academic Advisor (or Instructor if a course project)

Dr G Kysela

University Address: Dept. of Educ. Psychology, 3-104

University Telephone: 492-5026

March 21st 1994

Signature of Principal Investigator. In case of a graduate student, signature of faculty advisor.

Signature of Graduate Student(if applicable)

Date

APPENDIX 2

Department of Educational Psychology Research and Ethics Committee

March 28, 1994

From: Department of Educational Psychology
Research and Ethics Committee

The Research and Ethics Committee of the Department of Educational Psychology has reviewed the attached proposal and finds it acceptable with respect to ethical matters.

Applicants: Dr. G. Kysela on behalf of Julius Caesar Enon (graduate student)

Title: Teacher Efficacy, Teachers' and Students' Perception of Instructional Strategies in Mathematics

Participating Agency(ies):

Recommended Changes:

R Mulcahy
Chairman or Designate, Research
and Ethics Committee

March 29/94
Date

APPENDIX 3

Makerere University Academic Registrar's Letter of Introduction

MAKERERE UNIVERSITY

P.O. Box 7062, KAMPALA, UGANDA - Tel : 542471, 556681-5- Telegrams : MAKUNIKA, KAMPALA

ACADEMIC REGISTRAR'S OFFICE, TEL: 532752

YOUR REF:

OUR REF: 0231.05.115 27th April, 1994.

The Executive Secretary,
Uganda National Council for
Science & Technology,
KAMPALA.

Dear Sir,

re: ENON Julius Caesar.

The above named is a Lecturer in Educational Psychology at Makerere University. He was granted three years' study leave in October 1992 and is pursuing his Ph.D studies at the University of Alberta, Canada. He is on a CIDA scholarship which covers all expenses connected with his studies.

Mr. Enon expects to complete his Ph.D studies in October 1994. He has just returned to Uganda to do field work for a period of six months and he now requires permission to carry out the research. The title of his Ph.D research topic is "The Relationship between Teacher Efficacy, Teachers' and Students' Perceptions of Instructional Strategies and Achievement in Mathematics."

Every possible assistance rendered to Mr. Enon will be highly appreciated.

Thank you.

Yours faithfully,

p.p Dr. Mukwanason A. Hyuha,
ACADEMIC REGISTRAR.

c.c. Research Secretariat,
President's Office
P. O. Box 7168,
KAMPALA.

MAH/PNK/rm

APPENDIX 4

Application Form from President's Office for Researchers

RS. 6

PRESIDENT'S OFFICE,
RESEARCH SECRETARIAT,
P.O. BOX 7168,
KAMPALA, UGANDA.

APPLICATION FORM FOR RESEARCHERS WISHING TO CARRY OUT RESEARCH IN UGANDA AND TO USE GOVERNMENT ARCHIVES

(This form should be completed in five (5). Six (6) passport-size photographs must be attached to the completed forms).

SECTION A

1. Surname ....

2. Other Names ....

3. Date and Place of birth ....

4. Nationality ....

5. Passport No., Date and Place of Issue ....

....

6. Permanent Address ....

....

7. Address of Institution/Organisation of Association or Affiliation

....

....

8. Have you been sentenced or bound over by a Civil Court, or has a charge against you been dismissed by a Civil Court? If so give dates and circumstances ....

....

....

....

....

..../2..

APPENDIX 5

Approval of Research Project by U.N. C.S.T.

P. O. BOX 6884,
KAMPALA, UGANDA

Ref. SS 823 ..... Date 19th May, 1994 ....

Mr. Enon Julius Caesar, ...
Dept. of Education, Psychology,
Makerere University, ...
P. O. Box 7062,
....
KAMPALA.

Dear Sir/Madam,

This is to advise you that the Uganda National Council for Science and Technology has approved your research project entitled: "TEACHER EFFICACY AND PERCEPTIONS OF INSTRUCTIONAL STRATEGIES IN MATHEMATICS"

This approval is subject to:

(i) Clearance being obtained from the President's Office; and

(ii) Payment of a research administrative fee of US $ 200.

Please sign the attached Form UNCST. 7 on Publication arising from your research, and complete five (5) copies of RS 6 Forms herewith enclosed and return them to me together with six (5) copies (Passport size) of your recent photographs.

A research permit and an identity card shall be issued to you after the above conditions have been fulfilled.

Your remittances should be paid either in cash or into the following bank accounts:

(a) A/C Uganda National Council for Science and Technology, No. 010-02-07027-00 (for Uganda Shillings) or No. 32-0-90-07131-00-5 (for Foreign Currencies); Standard Chartered Bank (U) Limited, P. O. Box 7111, Kampala, Uganda; Fax No. (256) 41-231473, Kampala, Uganda and 242875.

(b) A/C Uganda National Council for Science and Technology No. C.A 6141 (for Uganda Shillings) or No. FGN 61 (for Foreign Currencies); Bank of Baroda (Uganda) Limited, P. O. Box 7197, Kampala, Uganda; Fax: 256-41-258263, Kampala, Uganda.

Yours faithfully,

Dr. Z. M. 'Nyiira
Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

APPENDIX 6

Research Clearance by U.N.C.S.T

UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

TELEPHONES: 250499 (General)
EXECUTIVE SECRETARY'S DIRECT LINE: 250431
TELEX NO. .... TELEFAX NO. 234579

76 BUGANDA ROAD
P.O. BOX 6884,
KAMPALA, UGANDA

Your Ref: ....

Date: 19th May, 1994

Our Ref: SS 823

The District Executive Secretary
Apac .... District

Dear Sir/Madam,

RE : RESEARCH CLEARANCE

This is to introduce to you Mr/~~Mrs/Miss/Dr~~ ... Enon Julius Caesar ....
who wishes to undertake a research study entitled "TEACHER EFFICACY AND PERCEPTIONS OF INSTRUCTIONAL STRATEGIES IN MATHEMATICS" .... for a period of Six months ....

The research has been approved by the Uganda National Council for Science and Technology, and cleared by the Office of the President.

Any assistance rendered to the researcher and his/her team will be highly appreciated.

Yours sincerely,

Paul Kabasa
for Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

APPENDIX 7

Permission by the Ministry of Education

Telegram: "EDUCATION."
Telephone: 234440.

In any correspondence on this subject please quote No. ME/2

THE REPUBLIC OF UGANDA

Ministry of Education and Sports,
Crested Towers,
P.O. Box 7063,
Kampala,
Uganda.

3rd May, 1994

TO WHOM IT MAY CONCERN

This is to introduce to you Mr. J.C. Enon who wished to undertake research in your district specifically in Primary Schools. The research study is entitled " TEACHER EFFICACY AND STUDENT PERCEPTIONS OF INSTUCTIONAL STRATEGIES IN MATHEMATICS IN PARTIAL FULFILMENT OF A DOCTORAL DEGREE (PHD)

He is a member of staff at Makerere University, school of Education.

The purpose of this letter is to request you to accord him the necessary assistance and co-operation.

MRKariisa
M.R. Kariisa (Mrs)
for: COMMISSIONER FOR EDUCATION

for COMMISSIONER FOR EDUCATION
Ministry of Education and Sports

APPENDIX 8

Research Clearance by City Council Of Kampala

City Council of Kampala

TELEPHONE : 231440 KAMPALA

IN ANY FUTURE CORRESPONDENCE
PLEASE QUOTE

YOUR REF. NO.

City Education Officer's Department
P.O. Box 2649
Kampala
Uganda

Date 20th May, 1994.

All Headteachers,
Kampala City Council
Primary Schools.

RE: RESEARCH CLEARANCE FOR MR. ENON JULIUS CEASER

This is to introduce to you Mr. Enon Julius Ceasar, who is a Lecturer at Makerere University School of Education. He is carrying a research entitled "TEACHER EFFICACY AND PERCEPTIONS OF INSTRUCTIONAL STRATEGIES IN MATHEMATICS" in Kampala Primary Schools.

You are hereby requested to accord him all possible assistance to enable him undertake this important National exercise.

EDUCATION OFFICE
KAMPALA CITY COUNCIL
P. O. BOX 2649, Kampala
Date 20-5-1994

Charles W. Masaba
DISTRICT INSPECTOR OF SCHOOLS

APPENDIX 9

Research Clearance by C.G.R., Kampala

Telegrams:
Telephone: 230218/230708
In any correspondence on
this subject please quote No. ADM.38

CENTRAL GOVERNMENT REPRESENTATIVE
KAMPALA DISTRICT
P.O.BOX 362
KAMPALA, UGANDA.

20th May, 1994

To All Chairmen RC I,
Kampala District,
KAMPALA.

THru: The District Education Officer,
Kampala District,
KAMPALA.

Please assist.
D.E.S.

EDUCATION OFFICE
KAMPALA CITY COUNCIL
P. O. BOX 2949, Kampala
Date 20/5/1994

RE: RESEARCH CLEARANCE - MR. ENON JULIUS CEASER

This is to introduce to you and to confirm that the above named gentleman is a Lecturer in the Department of Education Psychology, Makerere University. He is authorised to carry out research entintied "TEACHER EFFICACY AND PERCEPTIONS OF INSTRUCTIONAL STRATEGIES IN MATHEMATICS" in Kampala Primary Schools.

Please accord him all necessary assistance.

Byabagambi Katuku
for: DISTRICT EXECUTIVE SECRETARY/KAMPALA.

OFFICE OF THE
DISTRICT EXECUTIVE SECRETARY
P. O. Box 362 KAMPALA

APPENDIX 10

Clearance by Tororo District Administration

REF: EMISC/ED/11:

TORORO DISTRICT ADMINISTRATION,
EDUCATION DEPARTMENT,
P.O. BOX 490,
TORORO

13th June, 1994.

All Headteachers,
Primary Schools,
Tororo

RE: INTRODUCTION

This is to introduce to you Mr. Enon Julius Ceasar; the Uganda National Council of Science and Technology has cleared him to carry out research in Primary schools in Tororo district.

Please render him the necessary assistance.

(A.D. OGELLAN)

DISTRICT EDUCATION OFFICER, TORORO.

DISTRICT EDUCATION OFFICER
TORORO DISTRICT

c.c. The Central Government Representative,
Tororo District.

c.c. The Chairman,
RC V, Tororo.

c.c. The District Executive Secretary,
Tororo District.

c.c. The District Inspector of Schools,
Tororo District.

APPENDIX 11

Clearance by Tororo Municipal Council

TORORO MUNICIPAL COUNCIL

Telephones: 4530
4510

Our Ref: TMC/ED/90

Your Ref:

EDUCATION Department
P.O. Box 17,
Tororo-Uganda.

Date 13th June, 1994.

All Headteachers,
Tororo Municipal Council Committee
Schools,

The H/M____________________

Re: MR. ENON JULIUS CEASAR

This is to introduce to you the above underlined who has been permitted to visit Tororo Municipal Council Primary Schools for a research on "Teacher efficacy and Student perception on Instructional Strategies in Maths"

He is moving with all his other forcualities.

Please accord him the necessary assistance.

[illegible] CHELEBATI,
MUNICIPAL EDUCATION OFFICER,TORORO.

APPENDIX 12

Clearance by Apac District Education Office

APAC DISTRICT ADMINISTRATION,
EDUCATION DEPARTMENT,
P.O. BOX 10,
APAC.

TO WHOM IT MAY CONCERN:

This is to introduce to you Mr. J.C. Enon who is carrying out a research study entitled "Teacher Efficacy and student perceptions of instructional stategies in Mathamatics in partial fulfilment of a Doctoral Degree.

Mr. Enon is a member of Makerere University staff.

Please co-operate with him and give him all the necessary assistance.

(J.B. OKELLO-OBOTE)
ASSISTANT COMMISSIONER FOR EDUCATION/DISTRICT EDUCATION OFFICER/APAC:

DISTRICT EDUCATION OFFICER
APAC DISTRICT

JBOO/beat/

APPENDIX 1A

Demographic characteristics of Teachers

APPENDICES

In completing these questionnaires, you are kindly asked to be as open and frank as possible. The information you provide will be treated in strict confidence.

APPENDIX A1: DEMOGRAPHIC CHARACTERISTICS OF MATHEMATICS TEACHERS

(i) Name of teacher/student teacher: ______________________

(ii) Sex: ______________________

(iii) Name of school in which you are currently teaching: ______________________

____

(iv) District in which school is located: ______________________

(v) Geographic location of school: RURAL ☐ URBAN ☐

(vi) Teacher's College/University attended or attending: ______________________

____

(vii) Do you have a teacher's certificate: YES ☐ NO ☐

(viii) Grade of certificate: GRADE II ☐ GRADE III ☐ GRADE IV ☐
DIPLOMA ☐ GRADUATE ☐ OTHERS ______________________

(ix) Number of years of experience in teaching since graduation from College/University:
Less than 5 years ☐ 5 - 10 years ☐ Over 10 years ☐
Over 15 years ☐ Others ______________________

(x) How many years have you taught Mathematics at the primary level? ____________

(xi) What other subjects do you teach? ______________________

(xii) If given a choice, which subject would you prefer to teach? ____________

(xiii) Which class(es) do you teach Mathematics to? ______________________

____

(xiv) Given a choice, which class(es) would you prefer to teach Mathematics to? ________

____

(xv) How many pupils are in each class that you teach (size of the class)? ____________

____

APPENDIX A2

Teacher Efficacy Scale

APPENDIX A2: TEACHER EFFICACY SCALE

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate numeral to the right of each statement.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. When a student does better than usual, many times it is because I exerted a little extra effort.	1	2	3	4	5
2. The hours in my class have little influence on students compared to the influence of their home environment.	1	2	3	4	5
3. If parents comment to me that their child behaves much better at school than he/she does at home, it would probably be because I have some specific techniques of managing his/her behaviour which they may lack.	1	2	3	4	5
4. The amount that a student can learn is primarily related to family background.	1	2	3	4	5
5. If a teacher has adequate skills and motivations, she/he can get through to the most difficult students.	1	2	3	4	5
6. If students aren't disciplined at home, they aren't likely to accept any discipline.	1	2	3	4	5
7. I have enough training to deal with almost any learning problem.	1	2	3	4	5
8. My teaching training program and/or experience has given me the necessary skills to be an effective teacher.	1	2	3	4	5
9. Many teachers are stymied in their attempts to help students by lack of support from the community.	1	2	3	4	5
10. Some students need to be placed in slower groups so they are not subjected to unrealistic expectations.	1	2	3	4	5
11. Individual differences among teachers account for the wide variations in student achievement.	1	2	3	4	5
12. When a student is having difficulty with an assignment, I am usually able to adjust it to his/her level.	1	2	3	4	5
13. If one of my new students cannot remain on task for a particular assignment, there is little that I could do to increase his/her attention until he/she is ready.	1	2	3	4	5
14. When a student gets a better grade than he usually gets, it is usually because I found better ways of teaching that student.	1	2	3	4	5
15. When I really try, I can get through to most difficult students.	1	2	3	4	5
16. A teacher is very limited in what he/she can achieve because a student's home environment is a large influence on his/her achievement.	1	2	3	4	5

Appendix A2: Teacher Efficacy Scale *(continued)*

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate numeral to the right of each statement.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
17. Teachers are not a very powerful influence on student achievement when all factors are considered.	1	2	3	4	5
18. If students are particularly disruptive one day, I ask myself what I have been doing differently.	1	2	3	4	5
19. When the grades of my students improve it is usually because I found more effective teaching approaches.	1	2	3	4	5
20. If my principal suggested that I change some of my class curriculum, I would feel confident that I have the necessary skills to implement the unfamiliar curriculum.	1	2	3	4	5
21. If a student masters a new math concept quickly, this might be because I knew the necessary steps in teaching that concept.	1	2	3	4	5
22. Parent conferences can help a teacher judge how much to expect from a student by giving the teacher an idea of the parents' values toward education, discipline, etc.	1	2	3	4	5
23. If parents would do more with their children, I could do more.	1	2	3	4	5
24. If a student did not remember information I gave in a previous lesson, I would know how to increase his/her retention in the next lesson.	1	2	3	4	5
25. If a student in my class becomes disruptive and noisy, I feel assured that I know some techniques to redirect him quickly.	1	2	3	4	5
26. School rules and policies hinder my doing the job I was hired to do.	1	2	3	4	5
27. The influences of a student's home experiences can be overcome by good teaching.	1	2	3	4	5
28. When a child progresses after being placed in a slower group, it is usually because the teacher has had a chance to give him/her extra attention.	1	2	3	4	5
29. If one of my students couldn't do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty.	1	2	3	4	5
30. Even a teacher with good teaching abilities may not reach many students.	1	2	3	4	5

APPENDIX A3

Teacher Perception (Beief) Scale

APPENDIX A3: TEACHER PERCEPTION SCALE

Directions: Draw a circle around the letter that shows how closely you agree or disagree with each statement.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. The teacher should always work sample problems for students before making an assignment.	SD	D	U	A	SA
2. Teachers should make assignments on just that which has been thoroughly discussed in class.	SD	D	U	A	SA
3. Children should be encouraged to invent their own mathematical symbols.	SD	D	U	A	SA
4. Each student should be encouraged to build on his/her own mathematical ideas, even if his attempts contain much trial and error.	SD	D	U	A	SA
5. Each student should feel free to use any method for solving a problem that suits him best.	SD	D	U	A	SA
6. Teachers should provide class time for students to experiment with their own mathematical ideas.	SD	D	U	A	SA
7. Discovery methods of teaching tend to frustrate many students who make too many errors before making any hoped-for discovery.	SD	D	U	A	SA
8. Most exercises assigned to students should be applications of a particular rule or formula.	SD	D	U	A	SA
9. Teachers should spend most of each class period explaining how to work specific problems.	SD	D	U	A	SA
10. Teachers should frequently insist that pupils find individual methods for solving problems.	SD	D	U	A	SA
11. Discovery methods of teaching have limited value because students often get answers without knowing where they came from.	SD	D	U	A	SA
12. The teacher should provide models for problem solving and expect students to imitate them.	SD	D	U	A	SA
13. The average mathematics student, with a little guidance, should be able to discover the basic ideas of mathematics for himself.	SD	D	U	A	SA
14. The teacher should consistently give assignments which require research and original thinking.	SD	D	U	A	SA
15. Teachers must get students to explore beyond usual patterns of operation in math.	SD	D	U	A	SA
16. Teachers should provide class time for students to experiment with their own mathematical ideas.	SD	D	U	A	SA
17. The laws and rules of mathematics severely limit the manner in which problems can be solved.	SD	D	U	A	SA

Appendix A3: Teacher Perception Scale *(continued)*

Directions: Draw a circle around the letter that shows how closely you agree or disagree with each statement.	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
18. Studying mathematics helps to develop the ability to think creatively.	SD	D	U	A	SA
19. There are several different but appropriate ways to teach mathematics.	SD	D	U	A	SA
20. In mathematics, perhaps more than in other areas, there is originality and ingenuity.	SD	D	U	A	SA
21. The most important thing in teaching mathematics is to explain the content well.	SD	D	U	A	SA
22. In mathematics, there is usually just one proper way to state something.	SD	D	U	A	SA
23. Mathematics is an organized body of knowledge which stresses the use of formulas.	SD	D	U	A	SA
24. The language of mathematics is so exact that there is not much room for a variety of expression.	SD	D	U	A	SA
25. Students should be expected to use only those methods that their text or teacher uses.	SD	D	U	A	SA
26. All students should be required to memorize formulas.	SD	D	U	A	SA
27. Because of the large size of class, the lecture method of teaching is the most convenient.	SD	D	U	A	SA
28. The use of class discussion is a waste of time.	SD	D	U	A	SA
29. Most mathematics teaching for primary school pupils should focus on knowledge recall and comprehension as opposed to application and synthesis.	SD	D	U	A	SA
30. Pupils should be able to work out solutions to math problems without the teacher's interference.	SD	D	U	A	SA
31. I enjoy teaching mathematics.	SD	D	U	A	SA
32. In mathematics, it is essential that students work in team groups.	SD	D	U	A	SA
33. Students should be taught to think about their position in mathematics.	SD	D	U	A	SA
34. Math teachers should feel a greater responsibility to the content they teach than to how they teach it.	SD	D	U	A	SA

APPENDIX B

Mathematics Attitude Inventory

MATHEMATICS ATTITUDE INVENTORY

Directions

The following statements are about the study of mathematics. Please read each statement carefully and decide whether it describes the way you feel about mathematics. Then, find the number of the statement in the answer column (or on the answer sheet if one is provided), and blacken one of the spaces according to the following directions:

If you strongly agree with the statement, blacken space 1.

If you agree with the statement, blacken space 2.

If you disagree with the statement, blacken space 3.

If you strongly disagree with the statement, blacken space 4.

Be sure to blacken only one space for each statement.

Be sure to answer every question. You will have about 20 minutes to complete the 48 statements of the inventory. Remember to answer each statement according to the way you feel at the present time.

This instrument was developed for research purposes by the Minnesota Research and Evaluation Project. Copyright, 1972, by Wayne W. Welch, 210 Burton Hall, University of Minnesota, Minneapolis, Minnesota 55455. All rights reserved.

U OF MN EDUCATIONAL PSYCHOLOGY

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	Mathematics is useful for the problems of everyday life.	○ 1	○ 2	○ 3	○ 4
2.	Mathematics is something which I enjoy very much.	○ 1	○ 2	○ 3	○ 4
3.	I like the easy mathematics problems best.	○ 1	○ 2	○ 3	○ 4
4.	I don't do very well in mathematics.	○ 1	○ 2	○ 3	○ 4
5.	My mathematics teacher shows little interest in the students.	○ 1	○ 2	○ 3	○ 4
6.	Working mathematics problems is fun.	○ 1	○ 2	○ 3	○ 4
7.	I feel at ease in a mathematics class.	○ 1	○ 2	○ 3	○ 4
8.	I would like to do some outside reading in mathematics.	○ 1	○ 2	○ 3	○ 4
9.	There is little need for mathematics in most jobs.	○ 1	○ 2	○ 3	○ 4
10.	Mathematics is easy for me.	○ 1	○ 2	○ 3	○ 4
11.	When I hear the word mathematics, I have a feeling of dislike.	○ 1	○ 2	○ 3	○ 4
12.	Most people should study some mathematics.	○ 1	○ 2	○ 3	○ 4
13.	I would like to spend less time in school doing mathematics.	○ 1	○ 2	○ 3	○ 4
14.	Sometimes I read ahead in our mathematics book.	○ 1	○ 2	○ 3	○ 4
15.	Mathematics is helpful in understanding today's world.	○ 1	○ 2	○ 3	○ 4
16.	I usually understand what we are talking about in mathematics class.	○ 1	○ 2	○ 3	○ 4
17.	My mathematics teacher makes mathematics interesting.	○ 1	○ 2	○ 3	○ 4
18.	I don't like anything about mathematics.	○ 1	○ 2	○ 3	○ 4
19.	No matter how hard I try, I cannot understand mathematics.	○ 1	○ 2	○ 3	○ 4
20	I feel tense when someone talks to me about mathematics.	○ 1	○ 2	○ 3	○ 4
21.	My mathematics teacher presents material in a clear way.	○ 1	○ 2	○ 3	○ 4
22.	I often think, "I can't do it," when a mathematics problem seems hard.	○ 1	○ 2	○ 3	○ 4
23.	Mathematics is of great importance to a country's development.	○ 1	○ 2	○ 3	○ 4
24.	It is important to know mathematics in order to get a good job.	○ 1	○ 2	○ 3	○ 4
25.	It doesn't disturb me to work mathematics problems.	○ 1	○ 2	○ 3	○ 4

		Strongly Agree	Agree	Disagree	Strongly Disagree
26.	I would like a job which doesn't use any mathematics.	[✓ ○ 1]	○ 2	○ 3	○ 4
27.	My mathematics teacher knows when we are having trouble with our work.	○ 1	[✓ ○ 2]	○ 3	○ 4
28.	I enjoy talking to other people about mathematics.	○ 1	○ 2	○ 3	[✓ ○ 4]
29.	I like to play games that use numbers.	○ 1	○ 2	[✓ ○ 3]	○ 4
30.	I am good at working mathematics problems.	○ 1	○ 2	[✓ ○ 3]	○ 4
31.	My mathematics teacher doesn't seem to enjoy teaching mathematics.	○ 1	○ 2	○ 3	[✓ ○ 4]
32.	Sometimes I work more mathematics problems than are assigned in class.	○ 1	○ 2	[✓ ○ 3]	○ 4
33.	You can get along perfectly well in everyday life without mathematics.	○ 1	[✓ ○ 2]	○ 3	○ 4
34.	Working with numbers upsets me.	[✓ ○ 1]	○ 2	○ 3	○ 4
35.	I remember most of the things I learn in mathematics.	○ 1	○ 2	○ 3	[✓ ○ 4]
36.	It makes me nervous to even think about doing mathematics.	○ 1	○ 2	[✓ ○ 3]	○ 4
37.	I would rather be given the right answer to a mathematics problem than to work it out myself.	[✓ ○ 1]	○ 2	○ 3	○ 4
38.	Most of the ideas in mathematics aren't very useful.	○ 1	○ 2	○ 3	[✓ ○ 4]
39.	It scares me to have to take mathematics.	○ 1	[✓ ○ 2]	○ 3	○ 4
40.	My mathematics teacher is willing to give us individual help.	[✓ ○ 1]	○ 2	○ 3	○ 4
41.	The only reason I'm taking mathematics is because I have to.	[✓ ○ 1]	○ 2	○ 3	○ 4
42.	It is important to me to understand the work I do in mathematics.	○ 1	[✓ ○ 2]	○ 3	○ 4
43.	I have a good feeling toward mathematics.	○ 1	○ 2	○ 3	[✓ ○ 4]
44.	My mathematics teacher knows a lot about mathematics.	[✓ ○ 1]	○ 2	○ 3	○ 4
45.	Mathematics is more of a game than it is hard work.	○ 1	○ 2	[✓ ○ 3]	○ 4
46.	My mathematics teacher doesn't like students to ask questions.	○ 1	○ 2	○ 3	[✓ ○ 4]
47.	I have a real desire to learn mathematics.	○ 1	[✓ ○ 2]	○ 3	○ 4
48.	If I don't see how to work a mathematics problem right away, I never get it.	[✓ ○ 1]	○ 2	○ 3	○ 4

APPENDIX C

Observation and Assessment Coding Guide

APPENDIX C: OBSERVATION AND ASSESSMENT GUIDE TO EVALUATING MATHEMATICS TEACHING

School: ____________________ **Topic of lesson:** ____________________

No. of pupils attending lesson: __________ **Related unit in maths course:** __________

Teacher: ____________________ ____________________

Status of Class Teacher: __________ **Duration of lesson:** __________

SCORE KEY
Very Good - 4 Good - 3 Average - 2 Below Average - 1 Unsatisfactory - 0

A: LESSON NOTES

Relatedness of lesson objective(s) to Unit Objective	
Appropriate choice of teaching aids	
Appropriate choice of teaching/learning activities	
Appropriate choice of practice examples	
Appropriate choice of evaluation exercises	

B: CLASSROOM ENVIRONMENT

Attractiveness of classroom (ventilation, lighting, walls, etc.)	
Size of classroom (optimum - 40)	
Suitability of sitting arrangement	
Availability of necessary teaching aids	

C: EFFECTIVE COMMUNICATION (TEACHING PROCESS)

Effective use of blackboard and other media	
Attention given to all pupils	
Ability to arouse pupils' interest in the lesson	
Evidence of learning from pupils	
Clear instructions/well organized	
Relaxed/lively atmosphere	
Lesson flow/cohesion	
Questioning technique	

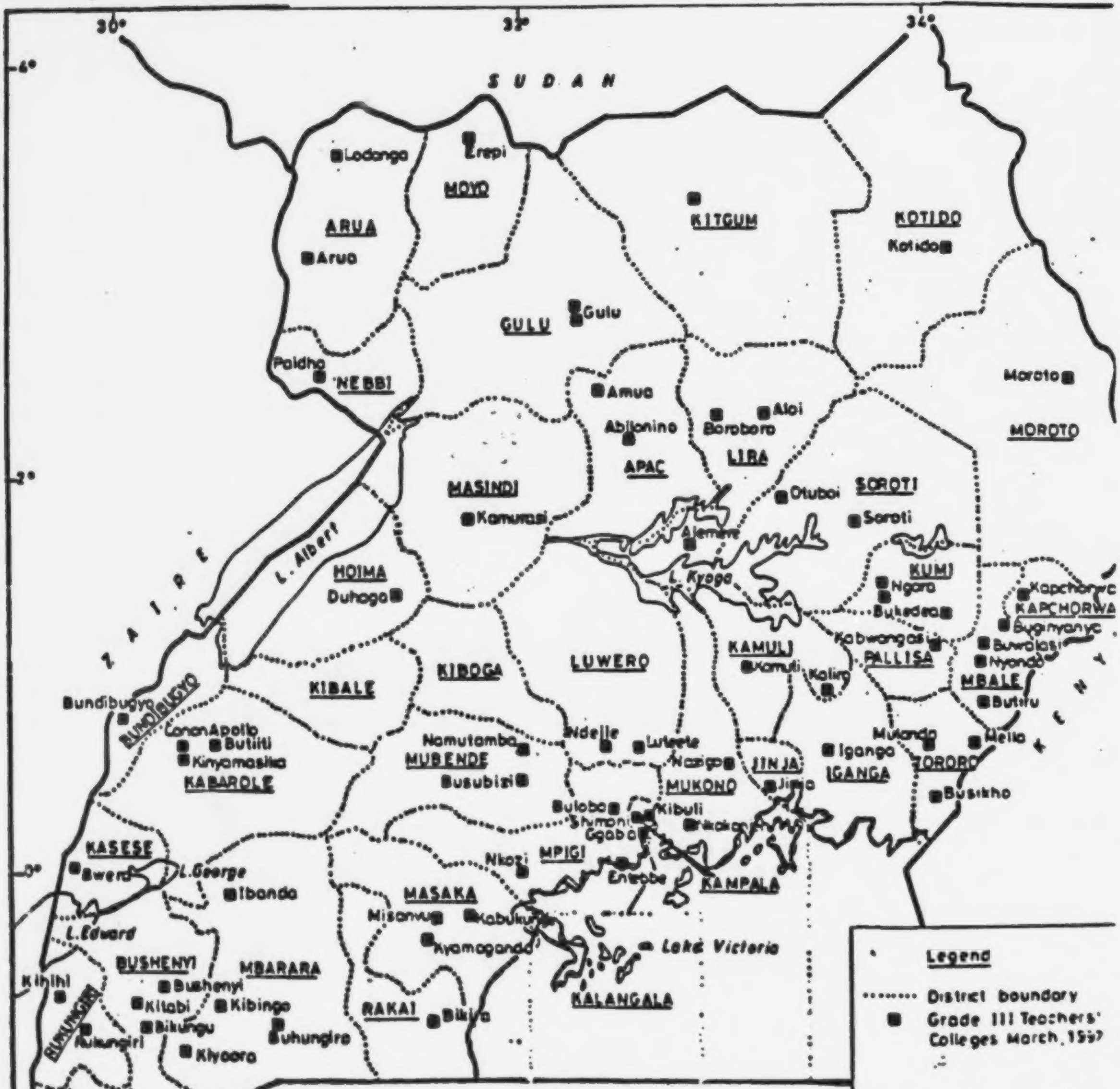
D: TEACHING STRATEGIES

Explanation	
Pupil participation/encourages participation	
Varieties of activities/approaches	
Contact with pupils	
Demonstration	
Discussion	
Pupil-pupil interaction	

APPENDIX E

Map of Uganda showing Areas of Study

Map 5. UGANDA:


30°
32°
34°
4°
2°
0°
SUDAN
ZAIRE
KENYA
TANZANIA
Lodonga
Erepi
MOYO
ARUA
Arua
KITGUM
KOTIDO
Kotido
GULU
Gulu
Paidha
NEBBI
Moroto
MOROTO
Amua
Abilonino
APAC
Boroboro
Aloi
LIRA
MASINDI
Kamurasi
Otuboi
SOROTI
Soroti
Alemere
L. Albert
L. Kyoga
HOIMA
Duhaga
KUMI
Ngora
Bukedea
Kapchorwa
KAPCHORWA
Bugunyanya
Buwalasi
Nyondo
MBALE
Bututu
Kabwangasi
PALLISA
KAMULI
Kamuli
Kaliro
KIBALE
KIBOGA
LUWERO
Bundibugyo
BUNDIBUGYO
Canon Apolo
Butiiti
Kinyamasika
KABAROLE
Namutamba
MUBENDE
Busubizi
Ndejje
Luteete
Nazigo
MUKONO
JINJA
Jinja
Iganga
IGANGA
Mulanda
TORORO
Mella
Busikho
Buloba
Shimoni
Kibuli
Ggaba
Nkokonjeru
KASESE
Bwera
L. George
Ibanda
Nkozi
MPIGI
Entebbe
KAMPALA
MASAKA
Misanvu
Kabukunge
Kyamaganda
L. Edward
Lake Victoria
BUSHENYI
Bushenyi
MBARARA
Kihihi
Kitabi
Kibingo
Bikungu
Rukungiri
RUKUNGIRI
Ruhungiro
Kiyoora
RAKAI
Bikira
KALANGALA
KISORO
KABALE
Legend
District boundary
Grade III Teachers' Colleges March, 199
0 30 60
km